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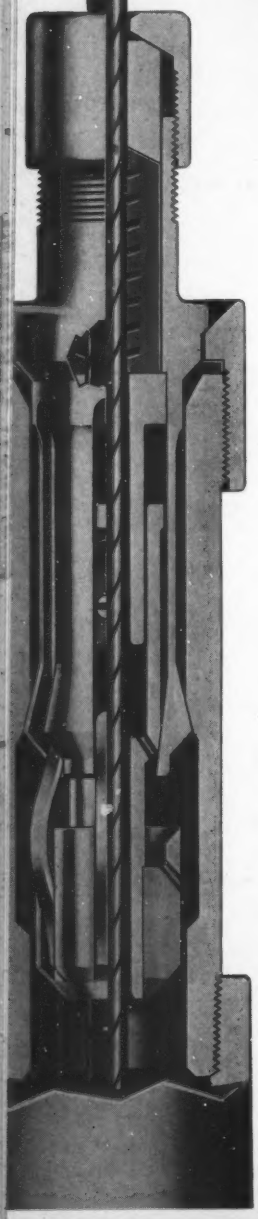

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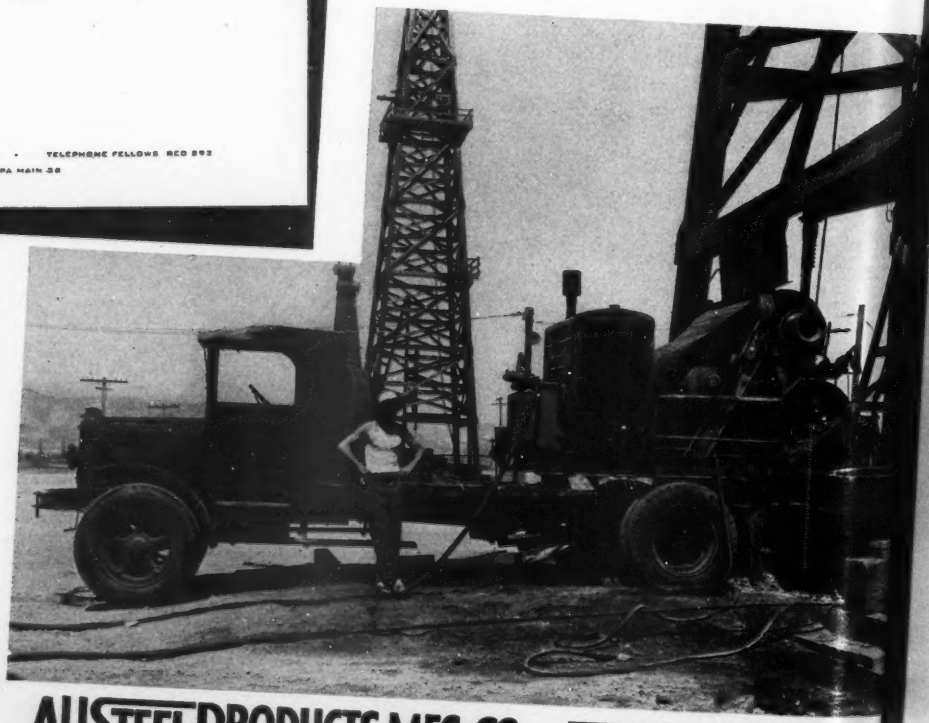

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Deep Zone Developments In Torrance Field

Discussed by Petroleum Engineer

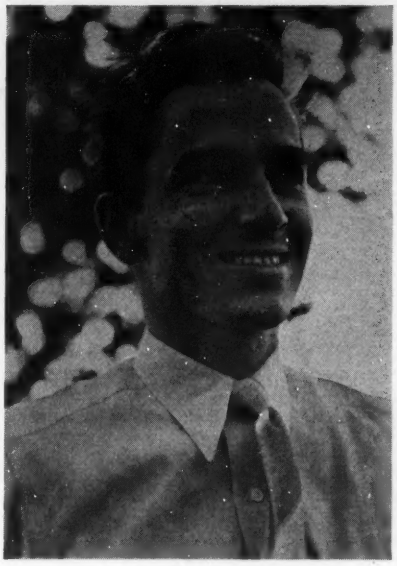
By James A. Bermingham, Jr., Petroleum Engineer, The Texas Co., Long Beach, Calif.

The deep zone in the Torrance field began to attract attention among Los Angeles Basin developments in the early part of January of this year. At that time six flowing wells had been successfully completed in the Lomita portion of the Torrance field, producing from a newly discovered deep zone.

The Lomita area is located in the southeast quarter of the central portion of the Torrance field. The early completions in the deep zone in this area were Chanslor-Canfield Midway Oil Company "Torrance 34", E. H. Grubbs "Torrance 3", Timco Oil Company "Torrance 1" and Four-way Oil Company "Torrance 1". The above wells were completed in December, 1937, flowing with initial productions ranging from 200 to 250 B/D of 27° gravity clean oil.

This new deep sand in the Lomita area was readily correlated to be the equivalent horizon in which the C. C.M.O. Oil Company had completed their "Del Amo 23'" in the latter part of 1936. The "Del Amo 23" discovery well, which is located high on the Torrance structure and in the central portion of the field, was cored continuously from the upper Main zone to the schist basement encountered at 4817 feet. Efforts to obtain commercial production in 50 feet of conglomerate overlying the schist proved futile. The well was plugged back to 4430 feet and gun perforated in an interval of oil sands interstratified with streaks of shale from 4430 to 4395 feet. In November, 1936, it was completed flowing 120 B/D of 27° gravity clean oil.

Following the success of "Del Amo 23" several operators commenced operations to deepen their wells on leases immediately to the south of the C.C.M.O. "Del Amo" lease. In these tests the Del Amo zone was encountered at 4275 feet and consisted of 70 feet of hard, gray brown and brown shales interbedded with streaks of fine grained, silty oil sand. Initial completions from the deep zone in this portion of the Torrance field ranged from 50 to 100 B/D of 25° to 27° gravity oil with a moderate cut. However, activity was short lived due



James A. Bermingham, Jr.

to the rapid encroachment of edge water.

Interest in the deep zone was renewed when the previously mentioned flowing wells were completed in the Lomita town-lot portion of the field. A renewal of competitive town-lot drilling occurred in the early part of February with the immediate commencement of twenty-two redrill-deepening jobs. In the early period of development of the deep zone, activity was concentrated within the productive limits of the upper Main zone.

Competitive Drilling Rapid

Early cross-sections through the Lomita area indicated that the Del Amo zone possessed characteristics of overlapping flank sands which became progressively sandier toward the south and east. This early observation was substantiated by later developments.

In the eastern portion of the Lomita area down the plunge of the structural nose, penetration of the zone is restricted, due to edge water, only the upper 20 or 30 feet of the lower Del Amo sub-zone can be taken and the initial productions are small, less than 200 B/D. In contrast, to the southwest, in the vicinity of 233rd and Pennsylvania Streets (see map) on the south flank of the structure, the largest flush producing Del Amo zone wells were completed for initial productions ranging from 500 to 1100 B/D from 120 feet of formation. The large completions in this portion of the area can be attributed to a favorable increase in the sand percentage within the zone and to its position on structure, which permitted full penetration of the zone with clean completions. An intense close drilling campaign has taken place in this relatively prolific section with the result that rapid drainage of the reservoir has produced a steep decline in the production.

The productive limits of the Del Amo zone have been defined by edge conditions obeserved in wells to the south. The drilling campaign to the deep zone in the Lomita area reached a climax on August 25 when there were 48 drilling wells and 11 derricks. On September 7 there were only 27 drilling or active rigs.

Geology

A generalized geological column of the stratigraphy in the Lomita portion of the Torrance field is shown in Figure 1. The Pliocene-Miocene contact in the Lomita area occurs at 3300 feet. The upper Main zone varies in thickness from 300 to 400 feet and consists of fine grained, well saturated, oil sands (30%

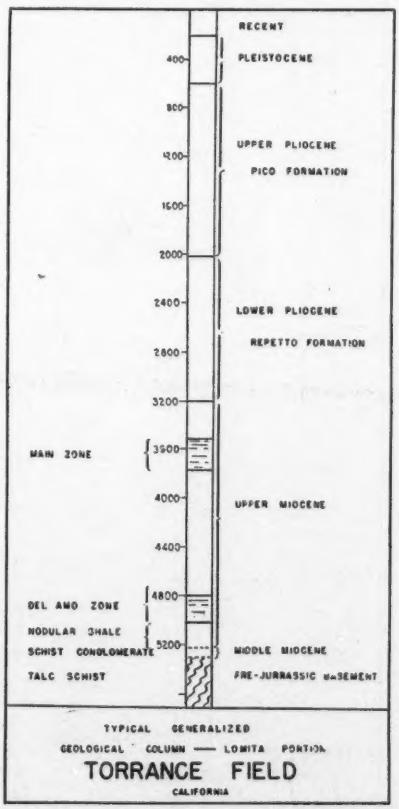


Figure 1.

of zone), interbedded with streaks of hard gray-brown and brown shales.

The Del Amo zone is encountered 1100 feet below the base of the upper Main zone. The Del Amo zone has been divided into Upper and Lower subzones (Figure 2).

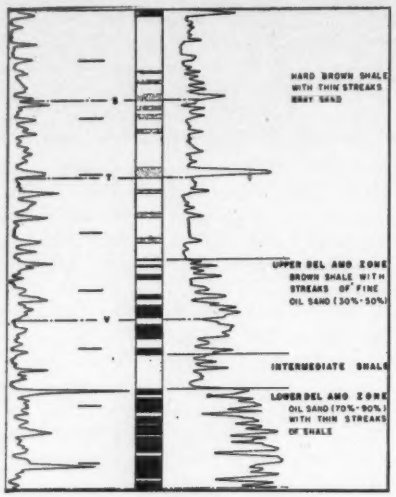

HARD BROWN SHALE WITH THIN STREAKS GRAY SAND
UPPER DEL AMO ZONE BROWN SHALE WITH STREAKS OF FINE OIL SAND (30%-50%)
INTERMEDIATE SHALE
LOWER DEL AMO ZONE OIL SAND (70%-90%) WITH THIN STREAKS OF SHALE

Figure 2.

The upper Del Amo zone consists of 60 to 75 feet of oil sands (30% to 50%) interbedded with shale. The upper Del Amo zone is separated from the lower Del Amo zone by 30 to 50 feet of sandy shale with partings of gray sands and oil sands.

The lower Del Amo zone consists of 120 feet of fine to medium grained, poorly sorted, oil sands (70% to 90% of the zone) with occasional sandstone and limestone shells and thin shale beds. The oil measures vary from friable to firm in hardness and, locally, portions of the poorly saturated oil sands contain small amounts of diatomaceous material.

Structure

The structure of the Del Amo zone through the Lomita area conforms in a general way with that of the upper Main zone, the major feature being a portion of a plunging structural nose or salient trending southeast through the Lomita area.

The axis of the deep sand structure appears to lie about 2000 feet south of the axis of the upper Main zone, as shown on the accompanying contour map.

Dips on the south and southeast flanks of the structure vary from 4° to 8°.

There appears to be a slight terracing effect on the structure in the eastern portion of the Lomita area shown by a flattening out of the contours in this direction.

Faulting

The writer has indicated a minor cross-fault trending northwest - southeast through the Lomita area. A study of cross-sections through this area (Figure 3) indicates that the fault has approximately a 60 foot throw near Narbonne and 233rd Streets, and a 20 foot throw near 231st and Pennsylvania Streets. The south side of the fault is up thrown and

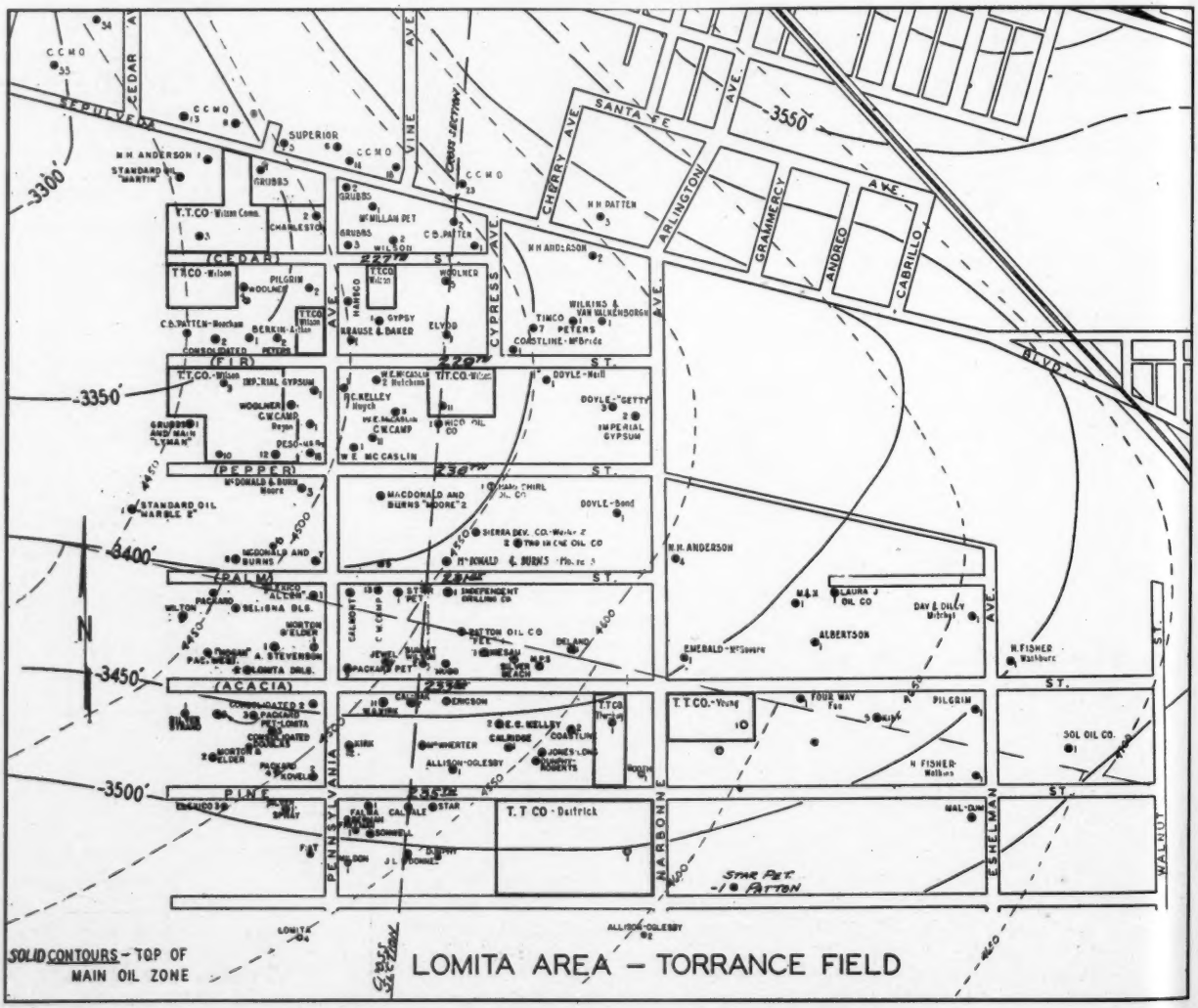


Fig. 3. Broken lines contour the "J" point on electrical logs.

the fault appears to have a 70° ± hade to the north.

It is felt that structural position and sedementary conditions had more bearing than faulting upon the accumulation of oil throughout the Lomita town-lot portion of the Torrance field.

Waters

The edge and bottom waters underlying the Del Amo zone are of high pressure with a static fluid head of 2900 feet, exerting a hydrostatic pressure of 1200 pounds per square inch.

The salinity of the bottom water ranges from 1300 to 1400 grains per gallon. A top water which entered several wells due to ineffectual water shutoffs appears to have a fluid level of 1400 feet from the surface. The top water also has a salinity range of 1300 to 1400 grains per gallon, making it impractical to attempt identification and classification of the top and bottom waters by means of salinity tests. The chemical analyses are also similar.

Near the base of the intermediate shale between the upper and lower Del Amo zones is a gray sand body 15 feet thick, which is hard and indurated in the highest portion of the structure through Lomita, but down dip the sand becomes friable and of increasing permeability. Down structure this sand body appears to be a possible source of intermediate water.

Casing Programs

The following is an outline of the general casing program used in drilling new wells to the Del Amo zone at Torrance:

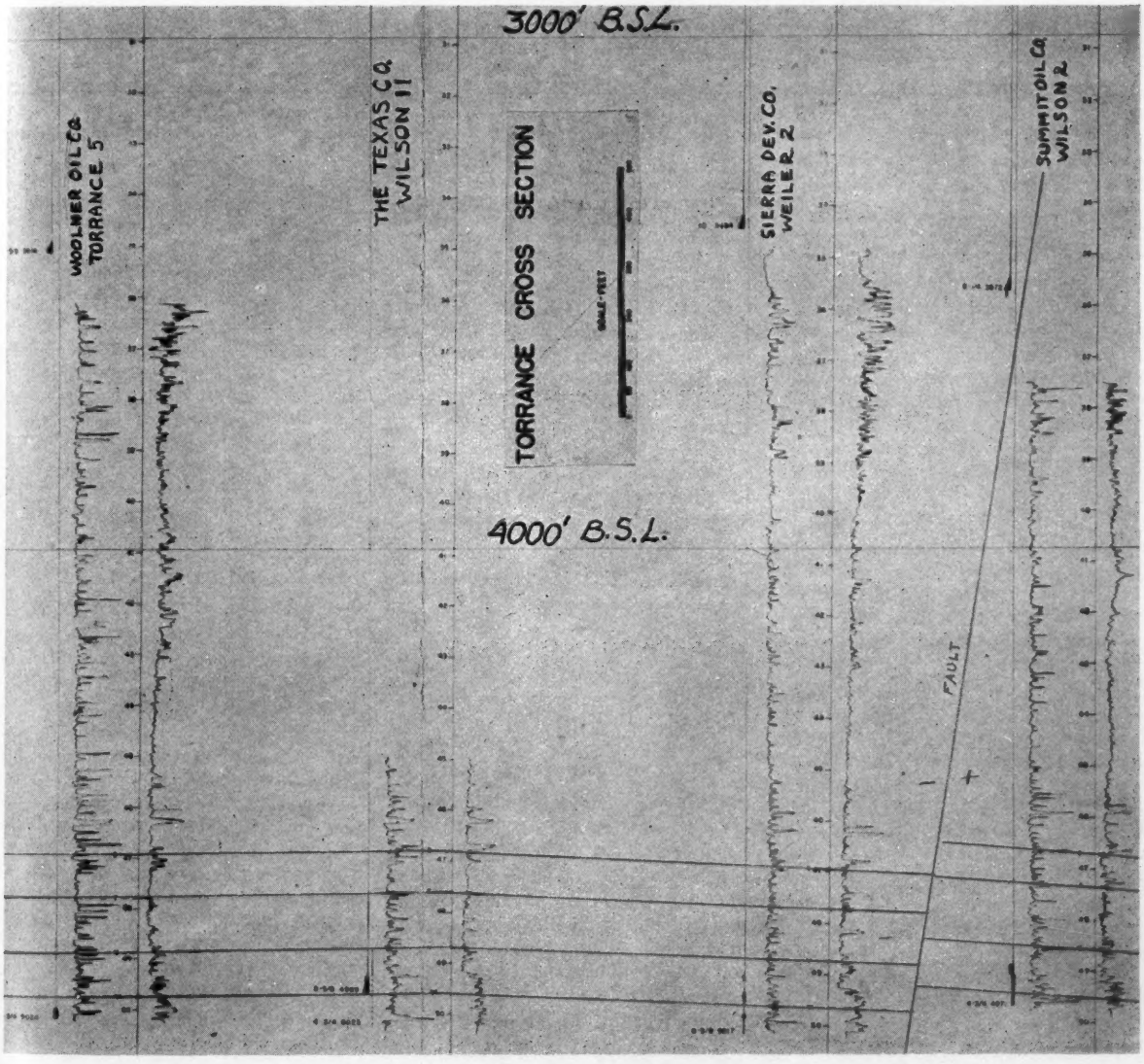
13⅜" or 10¾" surface casing at 600'.
8⅝" or 7" casing set at 4900' ±.
5¾" or 4¾" liner landed at 5000' ±.

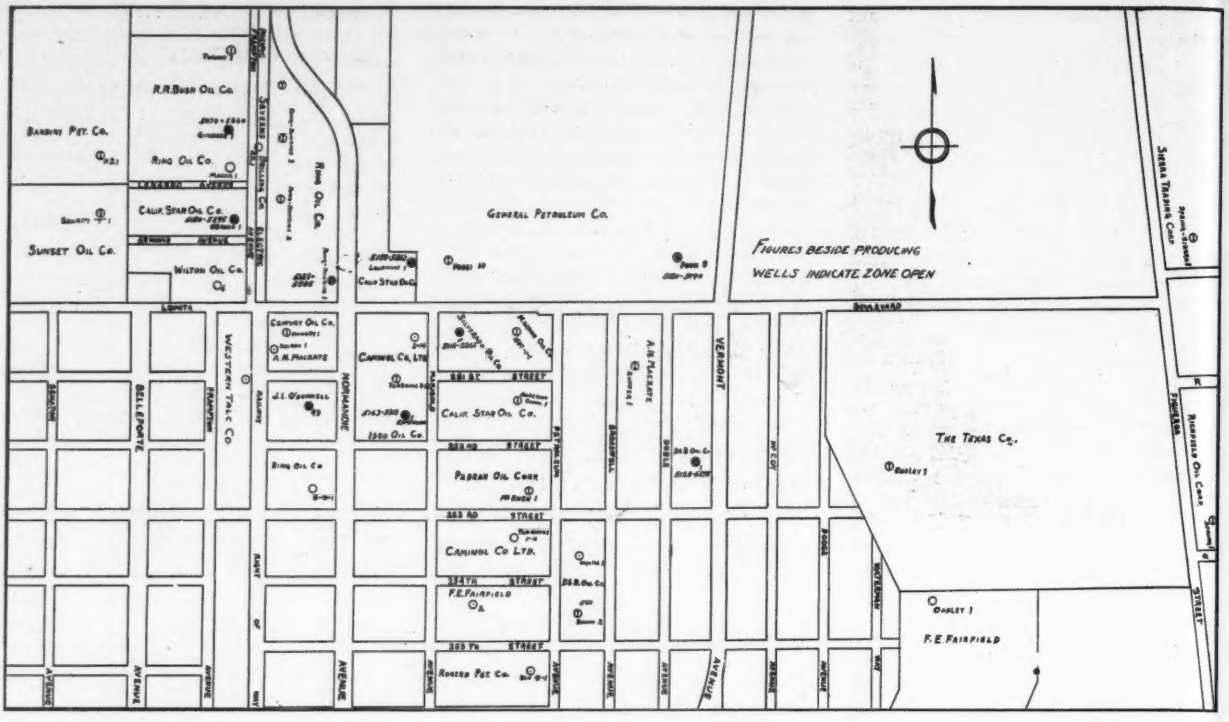
The State Division of Oil and Gas requires that sufficient cement be used in cementing the water string over the Del Amo zone to come up to 3200 feet between the casing and hole, thus protecting the upper Main zone at 3600 feet. In several wells the top of the cement, outside of the casing, was determined six hours after the cementing of the casing by a run of the Schlumberger cement locator (thermometric survey).

The usual length of liner varies from 225 to 150 feet, depending upon amount of formation taken. Perforation sizes range from 80 to 125 mesh and are usually 10 to 12 rows, with 2½" slots. Tyler screen analyses of the sands in the zone indicate that a 50 mesh screen is desirable to hold the sand, but actually, no sand trouble has been experienced, probably due to the firmness of the sand.

Production

The present daily production of the Del Amo zone of the Torrance field is 15,126 B/D from 115 wells. Production





figures indicate that the wells are showing a steep decline.

The rapid decline of the wells is the result of highly competitive town-lot drilling, the practice of producing the wells at full capacity, and the limited thickness of the Del Amo zone.

Although the average production per completion has been dropping since the early part of July, due to an increasing number of smaller completions, the total daily production from the Del Amo zone has increased from 11,682 B/D in July to 15,707 B/D from 91 wells in August, 1938. Of these wells 44 were flowing and 47 pumping.

In Figure 4, a tabulation of production figures from the Del Amo zone is shown indicating the increase from October, 1937, to August, 1938, inclusive. A close estimate of the total oil produced from the Del Amo zone to date is 1,440,181 barrels.

Practically all wells have been produced by means of 2½" tubing with a packer on bottom whether the wells flow or pump. This method of production is necessitated by the gas/oil ratios of about 500 cu. ft./bbl. There is hardly sufficient gas for flowing small wells, but too much for satisfactory pump operation. The packer and agitation provide the best known solution of the problem.

Harbor City Activity

With the production limits of the Del Amo zone defined in the Lomita area, interest is now directed to another portion of the Torrance field. The site of the new activity is in the extreme southeastern portion of the Torrance field and is referred to as the Harbor City area.

The first successful deep test in the Harbor City area was completed June 19, 1938, approximately 2000 feet south of the productive limits of the upper Main zone. This test, D. & B. Oil Company "Torrance No. 1," was completed from 5120 to 5275 feet for an initial production flowing 560 B/D of 30.2° gravity clean oil, 44/64" bean, 60 lb. tubing and 250 lb. casing pressures. Present production of the well is 230 B/D of 30.1° gravity clean oil, 18/64 bean, 110 lb. tubing and 880 lb. casing pressures.

The California Star Oil Company "O'Brien No. 1" was recently completed for an initial production of 466 B/D of 29.0° gravity clean oil, 24/64" bean, 150 lb. tubing and 100 lb. casing pressures. The third completion in the field was the California Star Oil Company "Lermans No. 1" completed for an initial production of 500 B/D of 29.0° gravity clean oil, 28/64" bean, 110 lb. tubing and 0 lb. casing pressures.

The deep zone produced in the Harbor City well consists of 160 to 175 ft. of hard brown miocene shale with occasional sandstone shales, interstratified with fine to medium grained, poorly sorted, friable, light brown oil sand. Oil sand makes up between 30-35% of the thickness of the zone. The productive horizon opened in the Harbor City wells (5120-5280 feet) is the upper and lower Del Amo sub-zones and is similar lithologically to that of the Lomita area. The upper Del Amo subzone is encountered 300′ ± structurally lower than it is found in the Lomita area. While production is obtained in Harbor City on the —5100-foot contour, a well drilled on this sub-sea contour in the Lomita area would find the Del Amo zone all water. It is interesting to note that the Del Amo zone occurs 1300 feet below the upper Main zone in both the Lomita and Harbor City areas.

It seems most likely that the accumulation of oil in the Del Amo zone in the Harbor City area is separated from the Lomita area by a cross-fault. This possibility is further indicated by an increase in gravity in the Harbor City area (29.0°—30.1°) as compared to the Lomita area (25.6°—27.0°).

The present gas/oil ratio of the early completions is averaging 500 cubic feet per barrel. The natural gasoline yield is ranging from two to three gallons per 1000 cubic feet.

At the present time there are seven wells completed in the Harbor City area, 17 wells are drilling, and an equal number in preliminary stages. Present knowledge of subsurface conditions in this interesting area is limited at this early stage of development. The current drilling campaign is expected to add materially to present knowledge within the very near future.

Production from the Del Amo zone in the extension area was 1937 barrels daily on October 3.

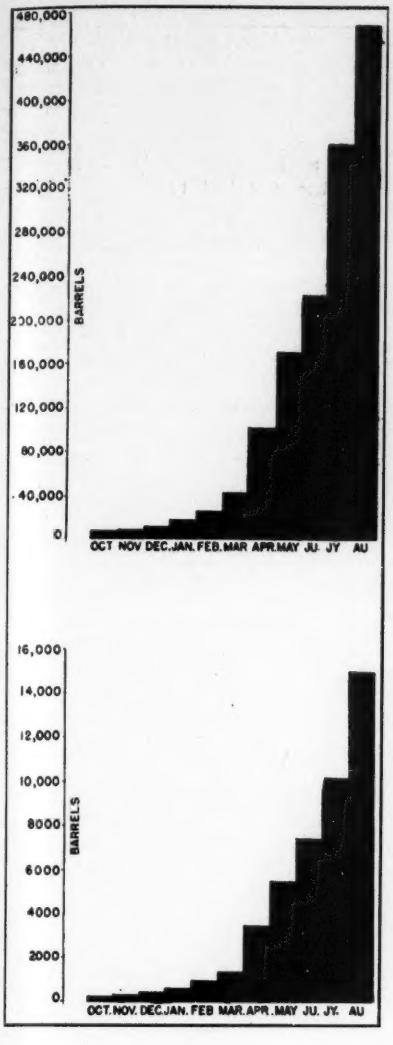


Figure 4.
The upper graph shows total monthly production, and the lower graph shows average daily production from the Del Amo zone.

"Practical Accounting for Oil Producers"

By Robert M. Pitcher

The need for a practical reference text book devoted to the subject of oil production accounting has been recognized for many years by both producers and accountants. For the purpose of meeting this need, Robert M. Pitcher has spent many months in preparing a book entitled "Practical Accounting for Oil Producers," which contains a non-technical, comprehensive treatment of the accounting problems peculiar to the oil producing industry. Mr. Pitcher has spent eighteen years actively engaged in various branches of the petroleum industry. His experience has been such as to bring him in close contact with the accounting division of the business, giving him an understanding of accounting problems as they appear to both an executive and an accountant.

Prior to his connection with the petroleum industry, Robert M. Pitcher had earned an enviable reputation as a public school teacher. He has written text books on arithmetic that have had extensive use.

E. L. Smith, drilling superintendent of California Star Oil Co., has reason to smile. Torrance has just started filling new tankage for his company.

"Practical Accounting for Oil Producers" is written fom the point of view of the oil man. It is absolutely practical and is written in plain, easy-to-understand language. Every principal feature of oil production accounting is thoroughly covered. Only recognized accounting principles and sound practice are presented throughout this book. Illustrations of practical forms are given wherever they will assist in a clear discussion of various accounting records. No pet theories are advocated. Accountants and oil men who have read the book recommend it as a valuable reference text book that can be used profitably by accountants and executives as well as by individual operators who are constantly confronted with problems beyond a simple record of income and expense.

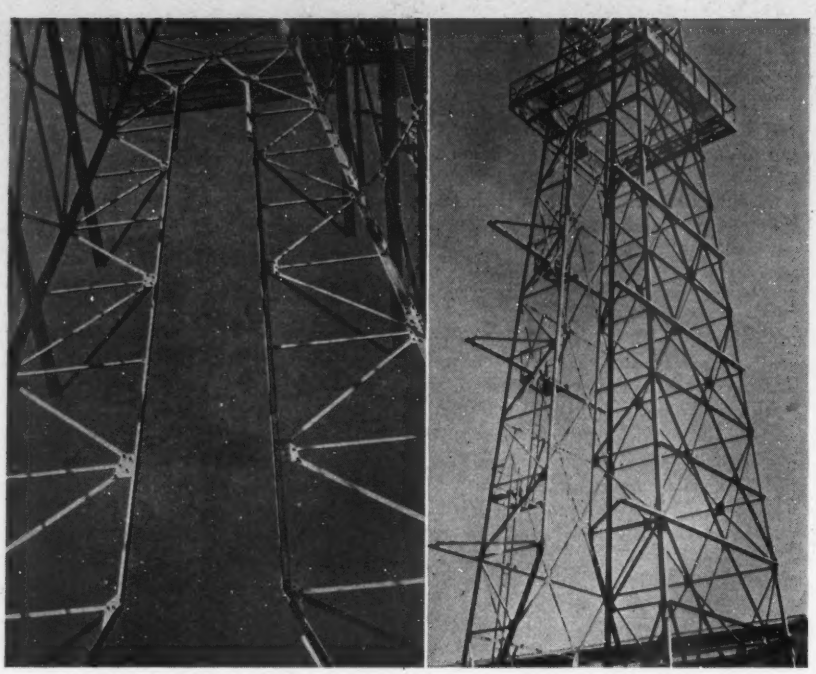
The book is published by The Mid-West Printing Company of Tulsa, Oklahoma, a firm that for twenty-two years has served the petroleum industry throughout the United States.

Gasoline Sales Up in August

The gasoline gallonage distributed last month amounted to 158,084,636, on which a tax of $4,742,539.08 was assessed. This amount represents a gain of $94,139.08, or 2.03 per cent over the tax assessed for the same month of 1937. It also represents a substantial gain over the tax of $4,548,146.85 reported for July of this year, and brought the total for the first eight months of the calendar year up to $34,288,539.15.

Oil companies reporting sales of more than 300,000 gallons in July were listed by the Board with the explanation that resale of gasoline previously taxed and exempt sales to the federal government or in interstate or foreign commerce accounted for differences between total sales and taxable sales. These companies were as follows:

NAME	Gallons Actually Sold	Net Taxable Gallonage
Aromalene, Inc.	656,071	647,778
Bachmann Petroleum Corp.	1,384,909	1,384,279
Bankline Oil Company	334,564	500
Barnsdall Oil Co. of California	349,952	None
Belridge Oil Company	1,470,011	52,523
Brown, Henry, dba Operators Oil & Refining	779,781	779,781
Caminol Company, Ltd., The	2,472,179	2,376,813
Chanslor-Canfield Mwy Oil Co.	559,576	None
Coline Gasoline Corporation	793,929	None
Cowan Oil & Refining Co.	631,274	None
Del Rey Oil & Gas Co.	703,200	None
Eagle Oil & Refining Co.	1,459,051	1,069,339
East West Refining Co.	501,153	359,136
El Camino Refining Co.	981,054	932,565
Elm Oil Co., Ltd.	440,128	440,128
El Tejon Oil & Refining Corp.	899,731	881,432
Envoy Petroleum Co.	879,248	879,248
Estado Petroleum Corp.	1,978,217	1,862,557
Exeter Refining Co., Inc.	1,212,888	1,212,807
Fletcher Oil Co., Inc.	2,064,163	None
F. R. Long, Inc.	1,928,004	None
Genl. Pet. Corp. of California	35,592,432	11,038,943
Gilmore-Dabney, Inc.	568,786	None
Gilmore Oil Company	6,616,136	180,669
Hancock Oil Co. of Calif., The	5,270,968	3,919,189
Harbor Refining Company	730,849	667,687
Honolulu Oil Corporation	757,124	8,880
Krieger Oil Company	1,140,836	1,138,503
Lomita Gasoline Company	1,984,401	None
Los Nietos Pro. & Ref. Co. Ltd.	3,073,640	771,651
Macmillan Petroleum Corp.	3,123,202	2,897,392
McCallen Refining Company	1,202,166	1,142,579
Meek, Herbert A., dba Henry H. Cross Co. of Cal.	497,734	None
Mohawk Petroleum Corporation	4,786,640	3,709,083
Mercury Petroleum Corporation	420,026	420,026
Moffett, J. O., (San Fernando Refining)	381,131	381,111
Norwalk Company, The	1,738,927	1,286,589
O. C. Field Gasoline Corp.	2,368,470	117,280
O. F. Collinge, Inc.	546,884	None
Olsen, G. Receiver Sunland Refining Corp.	648,054	None
Olympic Refining Company	1,470,518	1,468,202
Pacific States Oil & Term. Co.	2,064,635	1,838,796
Pacific Western Oil Corp.	556,407	941
Petrol Corporation, The	1,957,163	1,273,613
Petrolane, Ltd.	391,209	173,607
Richfield Oil Corporation	18,458,280	14,592,894
Rio Grande Oil, Inc.	3,879,138	None
Rothschild Oil Company	792,303	776,837
R. R. Bush Oil Company	1,294,481	1,139,163
Seaside Oil Company	3,840,245	1,336,433
Shell Oil Company	37,903,882	18,890,709
Socal Oil & Refining Co.	755,692	755,692
Signal Oil & Gas Company	1,429,157	None
Signal Oil Company	5,712,106	None
Standard Oil Co. of Calif.	73,134,495	25,473,716
St. Helens Pet. Co., Ltd., The	1,357,426	1,357,386
Sunset Oil Company	2,564,475	None
Superior Oil Company	2,591,550	21,138
Texas Company, The	10,332,377	8,409,818
Tide Water Associated Oil Co.	29,139,626	15,062,912
Triangle Oil & Ref. Co., Ltd.	675,208	675,208
Union Oil Company of Calif.	19,652,586	13,936,535
Walter Steiner Refining Co.	767,604	767,604
West Coast Refining Co.	439,042	None
Western States Gasoline Corp.	3,738,909	191,669
Wilmington Gasoline Co.	311,970	None
Wilshire Oil Company, Inc.	8,836,140	8,274,274
Seaboard Oil Co. of Delaware	1,515,548	None



Engineers View Revolutionary Derrick

A new type of steel derrick which is immediately striking in its revolutionary design promises to become popular in areas where the practice of welding casing joints is gaining ground. Petroleum engineers recently witnessed loading tests to determine resistance to torsional stresses in a mild steel 122-ft. derrick having a casing window 72 feet and 9 inches high.

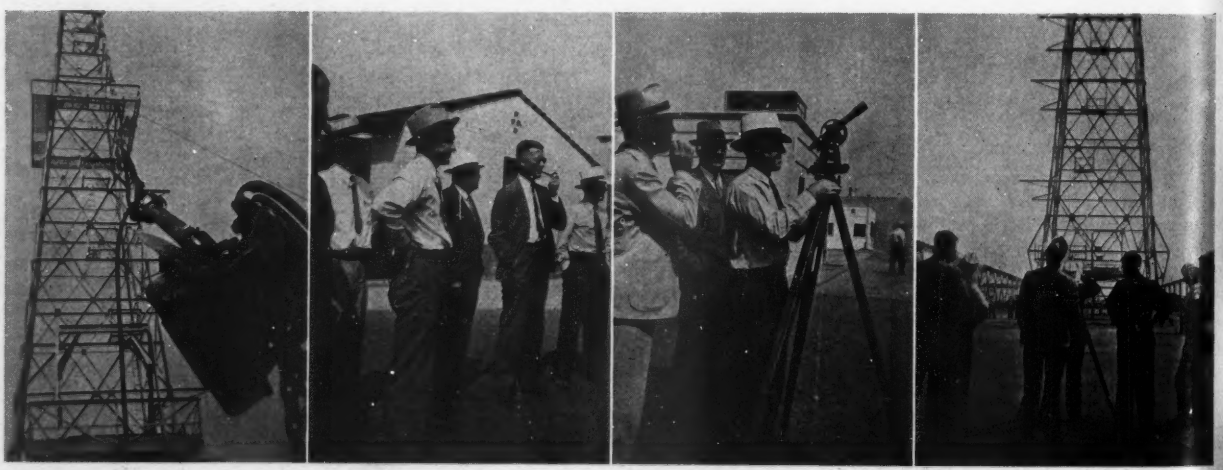
True, six reinforcing brackets were visible on the high casing window side, but until the dynamometers and transits told their story it was difficult to believe that the unprecedented rearrangement of so much metal on one side of a derrick would not affect the strength of the structure when submitted to heavy torsional stresses. While analysis of the design might indicate to the expert that there was no sacrifice in the capacity of the derrick to withstand more than the specified stresses or loadings, the tests conducted by Consolidated Steel Corp. and Buck & Stoddard, Inc., exclusive distributors, on their new type of steel derrick provided the assurances of strength and rigidity in a manner most desired by oil men, a practical, concrete exhibition with fully accepted equipment and standards.

Anchored at each of three vantage points correctly located around the derrick were systems of chain hoists, dynamometer, cable clamps and cables. One of these cables extended upward to the top of the tower, 125 feet and 4½ inches above the ground. The second cable was attached to the girt of the derrick 83 feet and 9¾ inches from the ground, and on an adjoining side on the same girt, the third cable was attached. Then by manipulations of the chain hoists various combinations of stresses were applied at the points where the cable was attached to the girt of the determine the distortion effect of these stresses, points were marked on the derrick and these points were sighted through transits. The oil company engineers present participated heartily in the testing procedure.

At the A.P.I. loadings specified for derricks of this size of the conventional type, distortion was negligible and the test indicated that far greater stresses might be applied with safety. The specified A.P.I. loadings were increased to 150 per cent, and then to 200 per cent, with results which were viewed with considerable satisfaction by the engineers assembled as well as by the manufacturers. The test data showed that there had been no sacrifice in strength in providing the high casing window which would greatly facilitate the handling of longer lengths of welded casing.

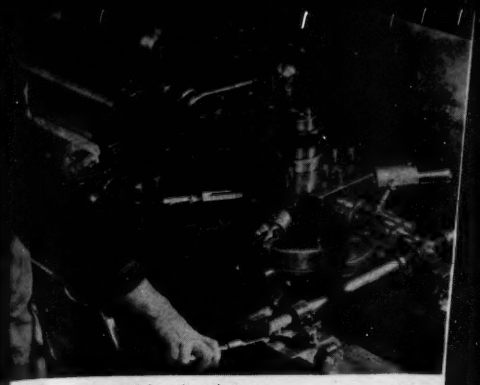
Proposal that the Nevada Reciprocity Act be repealed by the 1939 legislation has been made by the Nevada State Tax Commission.

Final ruling by the Interstate Commerce Commission on the gasoline weight case is not expected to be forthcoming for some time following recent developments.

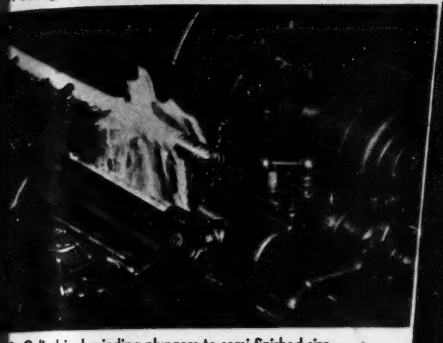


Petroleum Engineers from Standard, Union, General, Shell, Associated, Richfield and many other oil companies saw the radically new steel derrick pass the A.P.I. loading tests with flying colors.

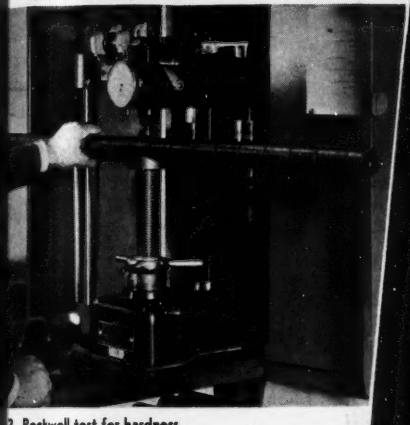
AXELSON PLUNGERS LIVE A STRAIGHT LIFE



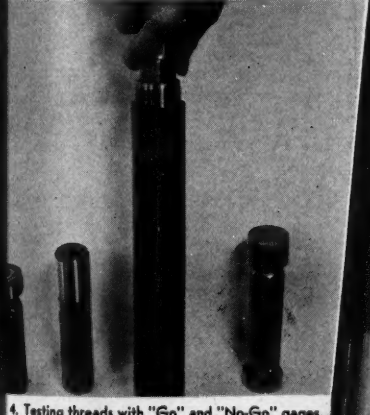
1. Boring, reaming and threading plungers.



2. Cylindrical grinding plungers to semi-finished size.



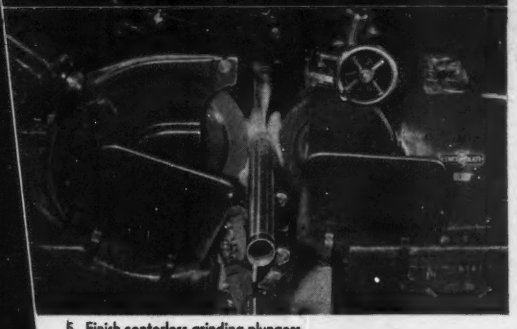
3. Rockwell test for hardness.



4. Testing threads with "Go" and "No-Go" gages.

An assembly of Axelson interchangeable liners in a pump of any length is as straight as a beam of light and smooth as glass inside. Within this polished cylinder an Axelson plunger with a mirror surface makes straight strokes with uniform metal-to-metal contact and minimum friction and wear in a well of any depth.

To realize this ideal result for the benefit of oil producers who keep an eye on output and unit costs, Axelson has devoted forty years to the study of materials and methods, and has pioneered in every improvement in deep well pump design. Fine parts make fine pumps. A few of the operations shown here in finishing Axelson plungers are characteristic of Axelson methods in the manufacture of all parts and final assemblies.



5. Finish centerless grinding plungers.

6. Polishing plungers to mirror finish in special machine.

7. Draining after dipping for rust prevention.

8. Final inspection.

AXELSON

DEEP WELL PLUNGER PUMPS • SUCKER RODS

AXELSON MANUFACTURING COMPANY — P. O. Box 98, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa

Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation

Rocky Mountain Distributor: Great Northern Tool & Supply Company

ERE IS NO
ONOMICAL
UBSTITUTE
R QUALITY

LAUGH THIS OFF

An employee of a local oil company, recuperating from a serious illness, was ordered by his physician to drink beer in order to build up his strength. He says the vivacious fluid has done him a world of good. When he first bought the barrel he could hardly move it, and now he can lift it right off the ground with ease.

Speaking of cures, **D. L. Shepherd** has discovered that the germs of sea sickness are helpless against a barrage of popcorn. On a recent deep sea fishing expedition he arrived at the dock with such a big can of the dainty that it had to be towed alongside on a barge. But it worked. Shep never had an uneasy moment, and is quite ready to endorse the curative properties of the bloated cereal for any manufacturer who will make it worth while.

And according to **Harold Linhoff,** in the oil business a man is known by the company he promotes.

It was Harold, you will remember, who was the author of the famous bon mot (French for "wise crack") that sat the literati back on their haunches some years ago. One of the C.N.G.A. lads, considerably disturbed about his eyesight, remarked, "I think I need different glasses." Says Harold, with more finesse than feeling, "Yeah, either different glasses or fewer."

George Grady, from whom we haven't heard for some time, comes to bat today with a cute story about a little operator down in Long Beach who expostulated, "Oh, the crazy fools! They know I'm located on State Street, so why the heck are they always looking me up in Brad Street?"

"It looks like a storm," said **S. Furman** to the gauger who had stopped at the house to deliver some urgent information, "I guess you'd better stay and have dinner with us." "Heck, no," replied the tape juggler, politely, "It's not bad enough for that."

Grover Kelley among other things asked the applicant for employment, "Are you unmarried?" And you could have knocked him over with a petty cash voucher, when the lad answered, "Yes, sir, twice."

After a ride on **Phil Rockfellow's** ranch horse, **Si Rubel** ventured the remark, "It's hard to believe that anything filled with hay could be so uncomfortable to sit on."

Bruce Barkis, deeply interested at the moment in vocational training, still wonders if, as is commonly believed, knowledge is power, why fighters make more in half an hour than the president makes in a year.

And **Thos. W. Simmons** recalls the distressing case of the young plant operator who accidentally backed into a compressor and got a little behind in his work.

But positively refuses to name the lad who changed to graveyard tour when the doctor told him he must give up all physical exertion.

With the advent of the football season, **Al. Jergins, Jr.,** suggests the posting of a notice as follows: "All employees who need Saturdays off for weddings or funerals must notify the superintendent by 10:00 o'clock one day prior to the game."

"Are you a college man?" asked **R. T. Colter,** and the applicant replied, "No, sir. A street car ran over my hat."

From **Blaine Johnston, Jr.,** comes the startling question, "If the Old Age Pension Plan goes through, I wonder if they'll pay the old burlesque girls with script and make script-tease dancers of them.

Added to this is a quip from the same individual who claims that "Sudeten Germans are no more than Cancelled Checks."

With which few remarks, we again leave you to your own devices. Remember, if you plant your elbows on the table solidly, even watermelon can be a balanced meal.

When You Use
BAKER CEMENT
EQUIPMENT
For GUIDING,
FLOATING and
CEMENTING
Your Casing

Complete, Safe,
DRILLABILITY -
due to the Use
of Only CONCRETE
And BAKELITE
For All Internal
Construction

State Drilling Report

Field	Company	Well	No.	Sec.	Twp.	Range
		NEW WELLS				
Torrance	R. R. Bush Oil Co.	Torino	1	25	4S	14W
	Elexico Oil Corp.	Elexico-Airey	4	22	4S	14W
	Lancia Oil Co.		1	23	4S	14W
	A. N. Macrate	Holden	1	25	4S	14W
	Richfield Oil Corp.	Spring	1	30	4S	13W
	Standard Oil Co.	Marble 1	15	22	4S	14W
	Wilton Oil Co.		6	25	4S	14W
	Ring Oil Co., Ltd.	Ring-Hawkins	2	25	4S	14W
	Ring Oil Co., Ltd.	Ring-Mahar	1	25	4S	14W
	Federated Oil, Inc.	Torrance	1	23	4S	14W
	Century Oil Co.	Howery	1	25	4S	14W
Richfield	Goodrich Oil Corp.		1	28	3S	9W
Dominguez	Union Oil Co.	Callender	64	33	3S	13W
Rosecrans	Bankline Oil Co.	Bradford	1	20	3S	13W
	Western Gulf Oil Co.	Bagg	1	17	3S	13W
	The Texas Co.	Colby	3	20	3S	13W
	The Superior Oil Co.	Maxwell Comm.	11	20	3S	13W
Potrero	Basin Oil Co.	Potrero	2	34	2S	14W
Wilmington	James Michelin	Community	2	32	4S	13W
	Richfield Oil Corp.	Pacific Dock	29	3	5S	13W
	Union Pacific Railroad Co.	Union Pacific	94	4	5S	13W
Brea-Olinda	Shell Oil Co.	Orange	20	2	3S	10W
Los Angeles County	The Texas Co.	Anderson Spring	1	9	2S	15W
	Hogan Petroleum Co.	Burkhard	1	7	5S	13W
McKittrick	Franco Western Oil Co.		16	8	30S	22E
Rio Bravo	General Petroleum Corp.	Wagoner	3	33	28S	25E
Mountain View	Hogan Petroleum Co.	Wharton	10	32	30S	29E
Kettleman—North	K. N. D. A.		78	22	22S	18E
	K. N. D. A.		65	20	22S	18E
	K. N. D. A.		32	22	22S	18E
Coalinga	Shell Oil Co.	Coast Range	21	17	19S	15E
	The Superior Oil Co.	Coalinga Fee	1	7	20S	16E
	Petroleum Securities Co.		88	7	20S	16E
Ventura	Tidewater Assoc. Oil Co.	V. L. & W.	36	25	3N	23W
	Tidewater Assoc. Oil Co.	Lloyd	128	27	3N	23W
Santa Barbara Co.	Richfield Oil Corp.	Tinaquaic	1	36	9N	32W
Mesa	Trans-Oceanic Oil Corp.	Mdivani	1	28	4N	27W
Elk Hills	Richfield Oil Corp.	Crampton	1-D (B)	1	31S	24E
Midway	Julius & Dorothy Fried	Julius & Dorothy Fried	1	34	32S	24E
Edison	Monterey Exploration Co.	Nichols	3	14	30S	29E
Canal	Shell Oil Co.	Canal A	43–14	14	30S	25E
Ten Section	Shell Oil Co.	KCL-A	72–29	29	30S	26E
	Shell Oil Co.	KCL-B	61–23	23	30S	25E
Round Mountain	Crestmont Oil Co.	Staley	5	8	28S	29E
	Grizzly Bear Petroleum Corp.	Kelly	1	6	28S	29E
	Honolulu Oil Corp.		59	20	28S	29E
	Shell Oil Co.	Olcese-Lilly	4	21	28S	29E
Kern River	Alfred Furhman		13	28	28S	28E
		DEEPEN OR REDRILL				
Santa Fe Springs	A. Wardman	Springs	1 & 2	6	3S	11W
Seal Beach	Alamitos Oil Co.	Judson	1	3	5S	12W
Long Beach	Exeter Oil Co., Ltd.	Western Noll	1	24	4S	13W
	South Basin Oil Co.		27	24	4S	13W
	The Texas Co.	Moore	2	19	4S	12W
	So. Calif. Drilling Co.	Miller	1	29	4S	12W
Dominguez	Shell Oil Co.	Reyes	35	33	3S	13W
Montebello	McVicar-Rood	Mans	2	2	2S	12W
	The Texas Co.	Mulholland	4	2	2S	12W
Torrance	Chas. W. Camp		11	23	4S	14W
	C. C. M. O. Co.	Torrance	15	15	4S	14W
	Silver Beach Oil Co.		1	23	4S	14W
Wilmington	Selegna Drlg. & Prod. Co.		5	32	4S	13W
Rincon	C. C. M. O. Co.	Hobson	B-1	16	3N	24W
Ventura	Tidewater Assoc. Oil Co.	V. L. & W.	41	24	3N	23W
Arroyo Grande	W. R. A. Oil Co., Inc.	Scott	1	5	32S	13E
Lost Hills	California Star Oil Co.		13	24	26S	20E
Midway	I. B. Dexter	Perris	8	15	32S	23E
Fruitvale	Harry H. Magee	Pasquini	1	23	29S	27E
Mt. Poso	Union Oil Co.	S & M	7 & 21	4	27S	28E
Mountain View	Shell Oil Co.	Porter Two	3	32	30S	29E
	Hogan Petroleum Co.	Symons-C.C.M.O.	3	4	31S	29E
	Wood-Callahan Oil Co.	National Oil	4	30	30S	29E
		ABANDON				
Orange County	H. K. R. Oil Co.		1	35	5S	11W
Newhall	E. A. & D. L. Clampitt		13	12	3N	16W
	E. A. Clampitt	Squaw Flat	1	18	3N	15W
	Eureka Crude Oil Co.		2	13	3N	16W
	West Coast Development Corp.	Broughton	2	27	4N	16W
Santa Fe Springs	The Texas Co.	Foix	1	6	3S	11W
Ventura County	So. Calif. Drilling Co.	W. P. D.	2	26	2N	21W
Mesa	Trans-Oceanic Oil Corp.	Morrison	1	28	4N	27W
Elk Hills	Richfield Oil Corp.	Crampton	1-D (A)	1	31S	24E
Round Mountain	Brown-Saffold Drilling Co.	Newberry	1	32	28S	29E
Kern County	Continental Oil Co.	KCL	B-2	12	29S	26E
Kettleman—North	K. N. D. A.		81	24	21S	16E
Montebello	The Texas Co.	Mulholland	2 & 3	2	2S	12W
Richfield	The Texas Co.	Isaac	1	33	3S	9W
El Segundo	The Texas Co.	Security	2	18	3S	14W
	Richfield Oil Corp.	Elsie	1	12	3S	15W
Huntington Beach	Sunset Oil Co.	Texcal	1	2	6S	11W
	Sunset Oil Co.	Bolsa Chica	2	2	6S	11W
Rosecrans	Barnsdall Oil Co.	Trust	6	18	3S	13W
Ojai	Holly Development Co.	Macrate	1	27	4N	23W
Mesa	Chas. L. Ross	Adams	1	28	4N	27W
Edison	Monterey Exploration Co.	Nichols	3	14	30S	29E
Fresno County	Jacalitos Petroleum Co.	Associated	1	14	21S	15E

Summary	This Week	Previous Week	To Date This Year	To Date Last Year
Total New Wells	17	31	903	1184
Total Deepened or Redrilled	8	17	601	506
Total Abandoned	12	11	387	392

VERNON TOOL CO.

Vernon

PUMPING UNITS SET A NEW STANDARD IN ECONOMICAL PUMPING

LOW FIRST COST

Exceptionally long stroke, sealed roller bearings and highest-quality reduction gears—features usually found only on expensive units—are standard equipment on VERNON Pumping Units *which sell for less than ordinary types.*

LOW OPERATING COST

Perfect balance and a wide range of stroke lengths and speeds assure a smoothness of operation that materially reduces power, rod and tubing costs.

LOW MAINTENANCE COST

Advanced design and the use of highest-quality materials throughout, provide unusually low maintenance costs for VERNON Pumping Units even in the most severe oil field service.

Twin-Crank VERNON Pumping Units are available in 10,000, 15,000 and 22,000 pound A.P.I. ratings; Single Crank Units in 7500 and 10,000 pound ratings. Send for descriptive literature and prices.

VERNON TOOL CO., LTD.
2740 EAST 37TH STREET, LOS ANGELES, CALIF.

PRODUCTION :-: DEVELOPMENT

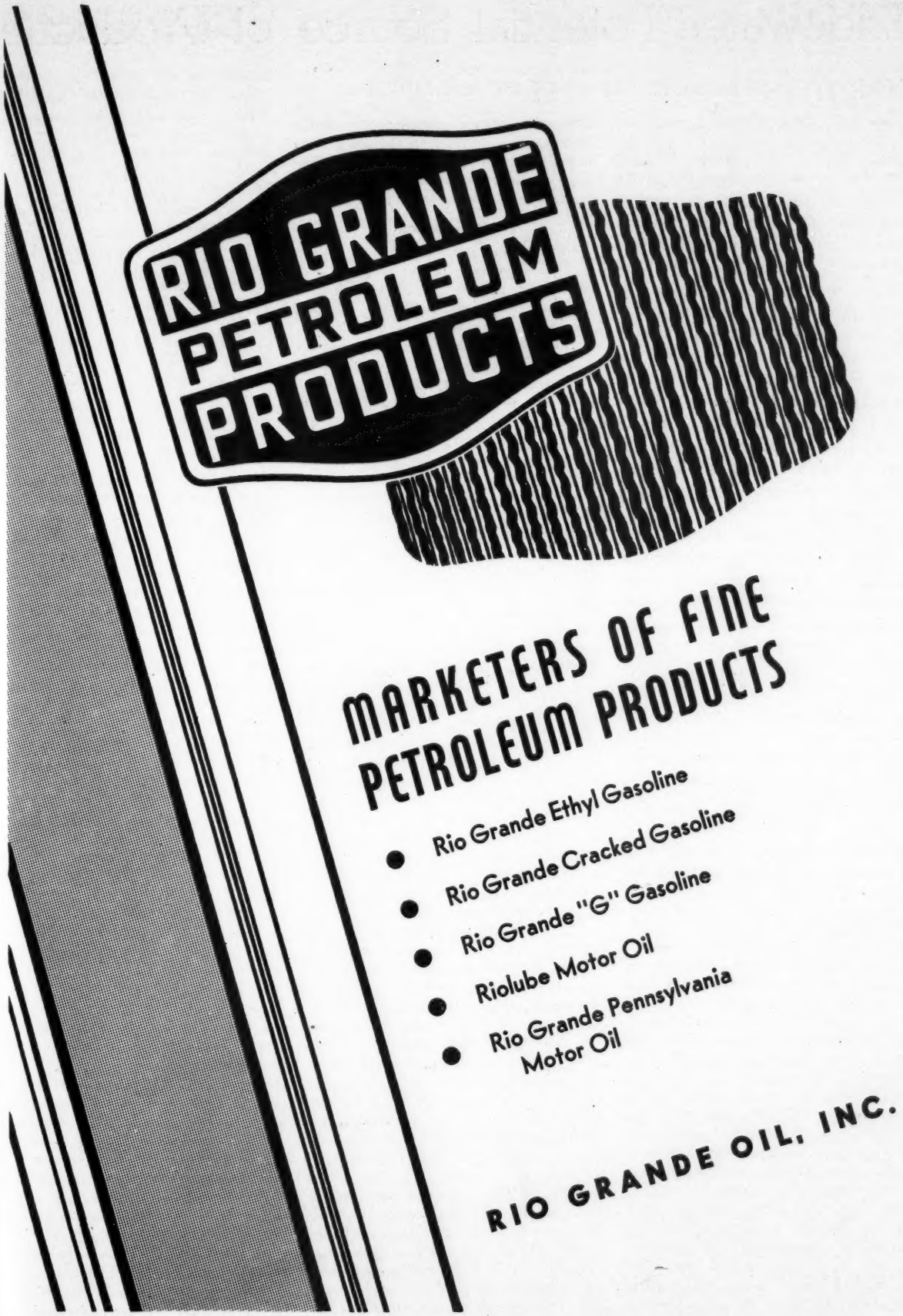
Figures of Production and Stocks are in barrels of 42 Gals.)

	Total Production August	—DAILY AVERAGE— Aug., 1938	July, 1938	Aug., 1937
Group No. 1				
Belridge—North	369,500	11,919	11,602	15,758
Belridge—South	33,170	1,070	1,033	1,682
Canal	86,809	2,800	2,441	.....
Canfield Ranch	2,870	93	107	.....
Coalinga	306,210	9,878	9,964	16,744
Edison	82,122	2,649	2,691	4,102
Elk Hills	326,423	10,530	10,541	10,505
Fruitvale	241,985	7,806	7,552	8,893
Greeley	92,810	2,994	3,291	1,737
Kern River	354,347	11,431	11,547	15,894
Kettleman Middle Dome	1,362	44	49	107
Kettleman North Dome	2,006,601	64,729	66,363	78,423
Lost Hills	105,102	3,390	3,708	3,523
McKittrick	102,694	3,313	3,131	4,460
Midway-Sunset	1,818,072	58,647	59,015	74,761
Mountain View	295,944	9,547	9,905	17,449
Mount Poso	468,356	15,108	15,760	18,149
Rio Bravo	249,807	8,058	5,640	.....
Round Mountain	428,034	13,807	14,564	13,473
Ten Section	233,824	7,543	6,949	3,081
Wasco	12,364	399	386	.....
Wheeler Ridge	9,605	310	309	320
Group No. 2				
Capitan	83,623	2,698	2,804	2,886
Elwood	169,646	5,472	5,781	8,192
Rincon	113,739	3,669	4,351	3,249
San Miguelito	72,846	2,350	2,399	3,469
Santa Barbara	13,750	443	405	644
Santa Maria	640,724	20,668	11,925	14,432
Summerland	801	26	28	32
Ventura Avenue	1,069,089	34,487	35,127	34,805
Ventura-Newhall	168,811	5,446	5,052	5,308
Watsonville	930	30	35	60
Group No. 3				
Brea-Olinda	174,903	5,642	5,818	6,098
Coyote—East	103,773	3,348	3,413	4,001
Coyote—West	255,049	8,227	8,480	7,130
Dominguez	788,013	25,420	23,772	29,097
El Segundo	244,953	7,902	9,431	11,247
Huntington Beach	987,087	31,841	32,303	35,656
Inglewood	438,032	14,130	14,179	15,755
Lawndale	2,485	80	90	78
Long Beach	1,764,928	56,933	58,122	57,957
Los Angeles-Salt Lake	13,596	438	543	566
Montebello	366,484	11,822	10,719	8,336
Playa Del Rey	182,127	5,875	61,38	7,939
Potrero	21,463	692	802	207
Richfield	279,007	9,000	8,959	8,824
Rosecrans	420,632	13,569	10,482	3,805
Santa Fe Springs	1,013,967	32,709	32,840	42,763
Seal Beach	260,975	8,419	8,651	9,507
Torrance	533,178	17,199	16,192	7,760
Whittier	29,031	937	925	902
Wilmington	2,928,207	94,458	94,768	53,656
Total	20,769,860	669,995	661,082	673,422
July	20,493,544	661,082		
Increase	276,316	8,913		

STOCKS HELD IN PACIFIC COAST TERRITORY BY CALIFORNIA OIL COMPANIES

	Aug. 31, 1938	July 31, 1938		August Changes	Dec. 31, 1937 Reclassified
1. Gasoline-Bearing Crude	33,099,463	33,022,559	+	76,904	29,417,842
2. Non-Gasoline-Bearing Crude	17,469,970	17,408,153	+	61,817	14,384,000
3. Unblended Nat. Gas.	3,356,516	3,312,990	+	43,526	2,001,204
4. Gasoline (not including distributing and service stations)	11,400,449	12,145,707	−	745,258	13,520,678
5. Naphtha Distillates	1,324,354[1]	1,377,637[1]	−	53,283	11464,577[1]
6. Gas Oil and Diesel Oil.	10,269,247	10,017,467	+	251,780	8,648,990
7. Fuel Oil Residuum	67,452,679	67,079,040	+	373,639	54,145,388
8. All Other Stocks	6,094,961	6,117,149	−	22,188	4,457,568
TOTAL	150,467,639	150,480,702	−	13,063	128,040,247
[1]Estimated amount of unfinished gasoline contained in item 5	1,134,150	1,175,980			1,248,291

	New Rigs Up	Active Drilling	Producers Completed	Daily Initial Output	Active Producing	ABANDONED WELLS Drillers	Producers
Group No. 1							
Belridge—North	2	5	2	5,145	62	....	....
Belridge—South	..	....	....	....	86	....	....
Canal	2	3	....	....	10	....	....
Canfield Ranch	..	....	....	....	1	1	....
Coalinga	1	10	1	7	803	....	1
Edison	..	1	1	85	85	....	....
Elk Hills	..	....	....	....	167	....	....
Fruitvale	1	1	3	580	170	....	1
Greeley	1	3	1	684	16	....	....
Kern River	1	1	5	365	1,358	....	....
Kettleman Middle Dome	..	....	....	....	3	....	....
Kettleman North Dome	3	11	3	4,796	198	....	....
Lost Hills	..	2	1	65	232	....	....
McKittrick	..	1	....	....	191	....	....
Midway-Sunset	2	4	2	20	2,434	....	2
Mountain View	..	....	....	....	190	....	3
Mount Poso	2	5	....	....	272	....	....
Rio Bravo	4	7	4	17,608	16	....	....
Round Mountain	2	2	1	576	198	....	....
Ten Section	3	4	3	7,256	28	....	....
Wasco	..	3	....	....	2	....	....
Wheeler Ridge	..	1	....	....	27	....	....
Group No. 2							
Capitan	2	1	2	1,138	49	....	....
Elwood	..	....	....	....	79	....	1
Rincon	1	....	1	108	46	....	....
San Miguelito	..	3	....	....	16	....	....
Santa Barbara	..	....	....	....	34	....	....
Santa Maria	2	6	4	3,290	226	....	1
Summerland	..	....	....	....	18	....	....
Ventura Avenue	1	8	3	1,095	213	....	....
Ventura-Newhall	1	7	....	....	550	....	1
Watsonville	..	....	....	....	7	....	....
Group No. 3							
Brea-Olinda	..	....	....	....	342	1	....
Coyote—East	..	....	....	....	86	....	....
Coyote—West	..	1	1	150	58	....	....
Dominguez	1	2	2	493	195	1	....
El Segundo	..	2	....	....	60	....	2
Huntington Beach	1	1	....	....	553	....	1
Inglewood	..	....	....	....	205	....	....
Lawndale	..	....	....	....	6	....	....
Long Beach	..	2	2	255	1,260	....	3
Los Angeles-Salt Lake	..	....	....	....	113	....	....
Montebello	7	10	6	6,042	219	....	1
Newport	..	1	....	....	....	....	....
Playa Del Rey	..	....	....	....	196	....	1
Potrero	1	....	....	....	12	....	....
Richfield	1	1	2	210	299	3	....
Rosecrans	5	8	4	4,607	99	....	....
Santa Fe Springs	..	....	....	....	661	....	....
Seal Beach	..	....	....	....	112	....	....
Torrance	24	31	23	6,693	585	1	....
Whittier	..	....	....	....	133	....	....
Wilmington	11	15	25	10,336	555	....	....
Miscellaneous Drilling	12	41	....	....	....	12	....
Group 4—Gas Fields							
Buena Vista Lake	..	1	....	....	1	....	....
Buttonwillow	..	....	....	....	....	....	....
Chowchilla	..	....	....	....	....	....	....
Delano	..	....	....	....	....	....	....
Dudley Ridge	..	....	....	....	....	....	....
Goleta	..	....	....	....	....	....	....
McDonald Island	..	....	....	....	4	....	....
Rio Vista	..	....	....	....	14	....	....
Semi-Tropic	..	....	....	....	1	....	....
Tracy	..	....	....	....	1	....	....
August	94	205	102	71,604	13,507	19	18
July	108	232	92	92,550	13,430	16	30
Decrease (*Increase)	14	27	10*	20,946	77*	3*	12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Edgewater Potential Source of Production

Energy Amenable to Proper Control

By F. G. Miller[2] and H. C. Miller[2]

Petroleum technologists and progressive operators constantly are striving to increase the percentage of oil that may be recovered from reservoir rocks through wells. The exhaustive studies that have been made of the function of natural gas in the production of oil, for example, have aided operators greatly in increasing the quantity of oil recovered from reservoirs. Natural gas dissolved in and otherwise associated under pressure with oil in reservoir rocks, however, is not the only source of energy available for moving oil through sands to wells. In becoming "reservoir-energy conscious" engineers have learned that in many petroleum reservoirs the edgewater flanking the oil accumulation constitutes a potential source of energy capable, through proper control, of increasing oil-recovery efficiencies materially. No longer is the encroachment of water into the oil- and gas-filled part of the reservoir considered as an evil to be combatted by devious methods but rather a natural consequence, incident to the withdrawal of oil and gas from the wells, that may be used advantageously in lengthening the flowing life of wells and increasing the economic recovery of oil and gas.

Little is known about the mechanism by which water operates in driving oil through reservoir rocks, and there is a scarcity of published information on rates of movement of water that will result in maximum oil recoveries. Bureau of Mines engineers appreciate the paucity of scientific knowledge on the best methods of applying the natural water drive to increase oil-recovery efficiencies and are initiating studies that will, they hope, contribute to the present small fund of information now available on the subject. This report is a synopsis or brief compilation of published data and thought accumulated so far, preliminary to laboratory experimentation and further research on the principles underlying the natural water drive as it affects oil recovery. The writers hope that the exposition of available information presented in the report will stimulate constructive thought and efforts leading toward more complete extraction of oil and gas from reservoirs.

Introduction

During the past decade, petroleum technologists have given a great deal of studied thought to the possibilities of using more efficiently the inherent energy in the natural gas dissolved in or otherwise associated under pressure with oil in reservoir rocks. There was a time when a majority of operators produced oil with no regard for the volume of gas accompanying it to the surface; but today such practice is roundly condemned by almost every producer, and no longer is there any doubt as to the benefits accruing in increased recovery of oil from reservoir sands through systematic control of gas-oil ratios. The preponderance of evidence, both laboratory and field, showing the benefits to be derived from efficient use of the energy inherent in the gas under pressure in reservoir sands has convinced even the skeptic that the production of oil with high gas-oil ratios leads not only to wastage of gas but results in reduced recovery of oil from the reservoir. As a result of the study and thought given to the value of the gas associated with oil under pressure in reservoir formations and to methods by which the gas can be used most efficiently to move oil through the sands to wells, oil-recovery efficiencies have increased and operators today are recovering much oil that would have been left unrecovered under former less-scientific production practices.

Gas under pressure, however, is not the only source of energy available in many reservoirs to drive oil through the pore spaces in the sands or rocks to the wells. In many of the petroleum reservoirs in the United States, oil is underlain by water under pressure and in volume sufficient to displace all the recoverable oil. In such fields, the energy required to produce the oil is not derived from the gas in solution or occluded in the oil and in the gas-filled part of the reservoir but is due to the head of water in the extraneous part of the reservoir. The entrance of meteoric water at the outcrop tends to maintain the pressure head in the oil-producing sands. Where the water contains considerable gas in solution, the water that moves into the oil-filled part of the reservoir receives its energy from the expansion of the fluids behind the oil. There, the force of the natural water drive can be used to best advantage in propelling oil to wells by producing the fields at a sufficiently low rate that the water furnishes all of the energy and completely replaces the oil in the pore spaces of the sand. If such control was made effective as soon as the first well in a field was completed, reservoir pressures could be maintained more nearly at their original intensity, no gas would be liberated from solution in the oil and thereby increase the viscosity of the oil and reduce the "effective permeability" of the sand, gas-oil ratios of production would be the same as formation gas-oil ratios, wells would flow naturally throughout their producing life, and oil-recovery efficiencies would be high.

Completely balancing withdrawal of oil with influx of water into a reservoir, however, usually results in noncommercial rates of oil production. Consequently, to produce oil at a profit, withdrawal rates for fields as a whole usually are higher than they would be if full advantage was taken of the energy of the encroaching water. Proration restrictions, by balancing output of oil against reservoir-pressure changes, have tended in a large measure to equalize withdrawal of oil and input of water. In some fields, however, due to the continued drilling of more wells, the rate of withdrawal of oil (and sometimes water) has exceeded, from time to time, the rate at which the energy of the water-filled part of the reservoir could be utilized efficiently. Field allowables, therefore, have been reduced at intervals, thereby indirectly effecting a more efficient utilization of the energy of the advancing edgewater.

Most engineers and operators appreciate that in many fields the water in the water-filled part of the reservoir sands is a potential source of energy great enough to drive all the recoverable oil to wells. What is not so generally understood is the mechanism by which water operates in driving oil through the reservoir sands and rocks. For that reason there is need for a symposium of the most authoritative opinions on the principles that underlie the natural-water drive as it affects oil recovery. The writers, therefore, have collected in this report much of the published technical information pertinent to the action of water in the production of oil. It is their hope that its publication will provoke a more general recognition of the importance, in the production of oil, of the water that is under hydrostatic pres-

sure in petroleum reservoirs and will result in more efficient utilization of the inherent energy in this water, thereby increasing oil-recovery efficiencies and reducing production costs.

Acknowledgments

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Edgewater Control Importance

In the Seminole field, Oklahoma, the volume and head of water in the Wilcox sand below the oil were sufficient to move oil through the sand by natural water flooding, and Millikan[4] attributed the high percentage of oil recovery (probably exceeding 50 percent of the original oil content of the reservoir) to the flooding action of the reservoir water.

Nye and Reistle[5] credited the slow encroachment of water and the maintenance of reservoir pressures in the East Texas field, under production restrictions in effect in 1933, for the high oil recoveries (65 to 75 percent) from the sand that has been flooded by water. In 1934, Reistle[6] again emphasized the beneficial result of conserving the reservoir energy and preventing the rapid encroachment of edgewater in the East Texas field by showing that such practices probably would result in increasing recovery efficiencies more than 10 percent over what might be expected under less efficient production methods.

McConnell[7], in discussing the effect of edgewater on the recovery of oil, agreed that edgewater properly controlled aids rather than decreases maximum oil recovery. He reported that if edgewater can be made to advance along an essentially uniform front, oil-extraction recoveries will be greater than if the water had been permitted to advance irregularly and permanently trap large bodies of oil in the reservoir sands.

The literature contains many references indicating that engineers are becoming "water conscious" and are beginning to realize that the encroachment of water into the oil- and gas-filled part of the reservoir is not an evil to be combatted by devious ways but a natural action that can be controlled and used to advantage in prolonging the flowing life of wells and increasing the recovery of oil and gas from reservoir sands.

Wright[8], for example, propounded that few phases of the petroleum industry hold greater promise for future benefit than study and control of the natural water drive. Wilhelm, Davis, and Clark[9], from experience gained in the California oil fields, considered that the importance of an adequate and controlled edgewater drive has not been fully realized, but that its importance was becoming apparent and was beginning to receive attention. Swensrud[10] stated that virtually no work of any importance has been done on the mechanism of displacement of oil by water in sands and suggested that, inasmuch as most crude-oil reserves are contained in reservoirs with an active water drive, the problem should be among the first to receive attention. Moore[11] also held that the water drive is an important agency in retarding the decline of reservoir pressure and thus conserving the energy of the reservoir. He, too, emphasized the fact that knowledge is very limited concerning the proper methods of operating oil fields to utilize the water drive to best advantage.

The various cited opinions of petroleum engineers can be augmented manyfold, but to do so does not appear necessary, as all of them can be summarized as definitely pointing out the fact that the natural water drive is an important agency in oil recovery and that present knowledge of the mechanism of the replacement of oil by water in sands is far from complete.

More than 17 years ago, Mills performed a large number of experiments in the San Francisco laboratory of the Bureau of Mines to study subsurface principles and relationships in reservoir sands. These experiments probably were the first ever conducted to study the effects of differences between underground conditions in texture and bedding in sands, and the modes of extracting oil from sands under the propulsive force exerted by hydrostatic pressure. The experiments were conducted in tanks containing models of typical geological structures built of sands and clays and equipped with plateglass fronts to facilitate making visual observations and photographic records of the changes that took place in the reservoir sands under different sets of conditions.

In his published reports, Mills [12 13 14] gave experimental evidence that the movement of oil and water in sands incident to drilling and operation of wells is governed largely by texture and bedding, and more especially by variations of these characteristics in the reservoir rocks. The experiments not only demonstrated that there are large losses of oil through retention in reservoir sands but established the causes for these losses. The qualitative conclusions presented by Mills should be given serious study by anyone interested in the development of improved methods of oil recovery.

Dodd's published work[15] on his experiments in 1921 also is an outstanding contribution to petroleum technology relating to movement of oil and water in reservoir sands. The experiments demonstrated that the difference in capillarity between water and oil is not a driving force and that capillarity tends to keep oil in its original position rather than to cause movement. The experimental evidence indicated that surface tension[16] at the water-oil interface and adsorption of oil at the water-oil interface are factors far more important than had been supposed theretofore.

Skirvin presented a report [17] in 1921, showing the results of experiments performed with the object of determining the physical properties manifested by crude oil, water, and sand, in contact with each other. The experiments showed that water invading an oil-saturated sand body composed of a relatively coarse-grained and a relatively fine-grained sand displaced (within certain limits) the oil from the coarse and not from the fine sand. Adhesion of oil to a sand particle was found to be a function of the attraction of the molecules of the substance composing the grain for the molecules of oil. Adhesion tends to retain as much oil as possible in contact with the surfaces of the sand grains; hence when adhesion is relatively small, the actual amount of oil that a sand surface can retain when the oil is subjected to a displacement force is small compared to the amount retained under similar conditions when the adhesion is great.

Skirvin concluded further that since viscosity is the result of internal molecular attraction or friction and adhesion is the attraction or friction at the surface of contact with sand particles, both phenomena work toward the same end to oppose any force that tends to remove the oil from contact with itself or with sand grains. Accordingly, invading water is considered to be less effective in removing moderately viscous oils from sands than in removing lighter or less viscous oils.

Although most of the results of the early investigations on the movement of liquids through sand bodies are qualitative and show only the relative magnitude of some of the different factors that influence the movements of oil and

water in sand, the groundwork thus established does afford an excellent background for further investigations. Obviously, quantitative results are necessary for any possible formulation of the variables affecting the invasion of water into oil-filled sands, and without such data the effect, for example, of the fineness of a sand on the percentage of oil recoverable by a natural-water drive for a given set of conditions cannot be evaluated. Furthermore, the rates of fluid movement maintained in the early experiments were much greater than the normal rates in natural reservoirs, and experimental data based on tests conducted at rates simulating those in effect in efficiently operated fields are needed.

Recent Investigations

Physical chemists have known, for some time, that a wide variation exists between the relative attraction of oils of different physico-chemical characteristics for silica (sand), and water for silica. Laboratory experiments have demonstrated that when two immiscible liquids are brought into mutual contact with a solid surface, the solid will be preferentially wetted by the liquid possessing the greater attraction for the solid. Of special interest to the oil industry is the fact that the investigations indicate that water will displace most crude oils from silica surfaces under ideal laboratory conditions.

Improvements in methods aimed toward increasing the efficiency of oil recovery by natural-water drive and by artificially water flooding partly depleted sands have been held back to some extent by the lack of fundamental data on the relative wetting power of oil and water for sand grains and the extent to which oil adhering to sand-grain surfaces can be displaced by aqueous solution. To extract some of the oil remaining unrecovered in reservoir sands by the usual methods of production, therefore, has been an incentive for studying the capillary phenomena relative to the physiochemical properties of oils, sand, and water as they relate to problems of oil recovery. Thus, the physical chemist has been called upon by the oil industry to aid in solving one of its most important production problems.

In studying characteristics of the wetting of solids by liquids, Bartell[18] and his associates devised a method for determining the attraction of a liquid for a solid by which they were able to assign a numerical value to the attractive force existing between the two phases. This force was expressed by them in terms of the adhesion tension or degree of wettability of the liquid against the solid. Adhesion tension is the difference between the surface tension of a solid and its interfacial tension against a liquid. Interfacial tension between a solid and a liquid will be small if the attractive force between the two phases is large. Apparently, then, adhesion-tension measurements indicate the attraction of a solid for a liquid or its wettability by the liquid. The surface tension of a liquid is a measure of the tensile strength per unit length of its surface film. Similarly, the interfacial tension between two immiscible liquids is a measure of the tensile strength per unit length of the interfacial film (film separating the two liquids). Surface tension and interfacial tension, therefore, are measures of surface energy per unit of area, and when the surface tension of a liquid has been determined the force necessary to rupture a unit length of the surface film can be computed.

The existence of surface tension of a liquid implies that each unit area of the liquid surface possesses an amount of potential energy numerically equal to the surface tension. Hence, surface tension provides a measure of surface energy. By this analogy it is not difficult to conceive that part of the molecular energy of a solid is manifested at its surface and that the surface energy per unit of area may be regarded as the surface tension of the solid. With these views in mind, adhesion tension or degree of wettability of a solid by a liquid has some physical significance in accordance with the definition as given, namely, the difference between the surface tension of a solid and its interfacial tension against a liquid[19].

Adhesion-tension determinations, however, can not be made directly, as no satisfactory methods are available for determining the surface tension of a solid or its interfacial tension against a liquid. To determine various liquid-solid adhesion tensions two immiscible liquids are brought into mutual contact on a solid surface and the displacement pressure exerted by the liquid of greater adhesion tension in displacing the liquid of lesser adhesion tension is measured. The rate of displacement of oil on sand (silica) by water is directly proportional to the temperatures of the liquids and inversely proportional to their viscosities. The viscosity of the oil, however, apparently has no relationship to the wettability (adhesion tension) of the oil against silica or on the displacement pressure. Numerous experiments also have shown that the adhesion tension of oil against sand is independent of the size of the pore spaces.

Oil adhering to the faces of sand grains is held there by molecular attraction between the two phases. If a liquid having a greater attraction than oil for the surfaces of the sand grains is brought into mutual contact with the oil and sand, it will displace the oil from the surface of the sand. Laboratory experiments by Bartell and coworkers show that water apparently will displace oil from grains of silica, and of all the crude oils used in their experiments none had a greater adhesion tension for silica than water. The adhesion tensions of the oils differed widely; water, therefore, had a different displacing tendency for each oil. Accordingly, the magnitude of the interfacial energy changes is different for combinations of oils of unlike physical characteristics and water.

Although Bartell's investigations indicated that water completely displaced oil from silica particles, experiments reported by Barnes[20] showed that oil-saturated sand cores still contained appreciable amounts of oil after having been subjected to "flooding" with various aqueous solutions under different pressures. Such differences as those cited pertaining to laboratory findings and field experience strengthen the view that further investigations are necessary to establish definitely the mechanism of oil removal from sands by water.

Garrison[21] also has called attention to the importance of the interfacial or film forces acting within the capillary pores of porous media and emphasized the function of capillary phenomena in the behavior of reservoir fluids.

Moore[22] expressed his belief that field observations substantiate the point brought out by Garrison, namely, that under original conditions, the contact plane or so-called water table is not level but is higher in "tight" than in more permeable sands. At high rates of production, the force required to move oil through the sand becomes much greater than the interfacial forces that account for the higher level of water in the tighter sands, and, therefore, the oil and water advance more rapidly through the permeable sands, leaving oil confined and trapped in the sands of lower permeability. At slow rates of production, however, the interfacial forces are operative and water tends to enter and drive the oil out of the pores of tightly packed sand more easily and completely than from the larger pore spaces in the adjacent sand. Thus, at some rate of production, edge-water theoretically should encroach uniformly into an oil sand composed of sand layers of different permeabilities and uniformly flush the sands of oil.

Although the importance of the interfacial forces acting within the capillary pores of reservoir sands is just beginning to be appreciated, Wyckoff[23] warned against assuming that capillary forces predominate to the virtual exclusion of the normal physical or "hydro-

dynamical" behavior when fluids are subjected to the pressure gradients incident to the withdrawal of fluids. He agreed, however, that capillarity phenomena which make the general problem of flow of mixtures of immiscible liquids through porous media so complex and different from the flow of homogeneous fluids, as more research is accomplished and additional data have been accumulated, may be found to be important in their relation to the flow of mixtures of immiscible liquids through sands. Wyckoff stated further that the problem of reservoir mechanics involving the flow of mixtures of oil, gas, and water will not be solved until the laws governing the flow of mixtures can be established with the same degree of certainty as those applying to the flow of homogeneous fluids.

Theoretical physics has supplied laws of liquid movement through uniform channels of simple form, but such laws are of little value in the study of movements of liquids through tortuous paths of varying cross-section in reservoir sands. Nutting[24] in 1925, appreciated that in the study of the flow of liquids through porous media, the effective pore section in a particular direction was of practical interest, and he showed by simple laboratory tests how the effective pore section could be determined. Knowing the effective pore section in a sand, movements of liquids under specific heads, pressures, or capillary forces can be calculated.

No attempt will be made here to summarize the experimental procedure or the calculations made by Nutting to determine qualitatively and quantitatively the effect of capillarity on the movement of oil and water through sands. Of immediate interest, however, are his published statements that the wetting of surfaces of solids by liquids involves both chemical and physical causes and his announcement that although the theory of the advance of a film of liquid over a plane solid surface had not been developed, the advance of the film involved chemical forces—at least for water and silica.

Nutting found also that water rose through coarse sand by a succession of double steps: (1) A creep over the surface of each grain by wedge action followed by (2) a capillary leap to neighboring grains near points of contact, and that the rate of rise was limited chiefly by the rate at which the supply of liquid was maintained.

Uren[25] and Bartell and Miller[26] do not wholly subscribe to Nutting's theory that water reacts chemically with silica and that wetting of sand grains by water may produce in a sand an affinity for oil. Further application of the adhesion-tension method to the study of the behavior of aqueous solutions in contact with solids may show that the flushing of oil from sands by water actually is due to interfacial-tension forces between the water and the oil and between the water and the silica rather than in accordance with the theory of Nutting.

From a study of Nutting's laboratory work it is apparent that molecular forces play an important role in the movement of edgewater in reservoir sands and that only part of the movement of edgewater up the dip of a structure is due to hydrostatic pressure. Consideration of the molecular forces active in sands of different permeabilities explains, at least in part, why water and oil do not always stratify in reservoir sands according to their densities. The fact that the maximum rise of oil or water in a fine sand is greater than in a coarse sand, as the experiments showed, and is directly proportional to the effective pore radius of the sand may explain why edgewater travels farther up dip in tight sands than in more permeable sands when differential pressures in reservoir sands are reduced. The experiments may be interpreted also to demonstrate that the influence of molecular forces tending to push water into tight sands and drive out the oil when conditions in the sand are favorable may be so great that only a small percentage of the oil may be left behind in the fine sand lenses by the advancing edgewater. Thus, it seems apparent that trapping of oil in sand bodies of low permeability might be avoided, or at least reduced, by lower rates of production. If the pressure drop across a sand body is high, the molecular forces are of no great importance, and the relative rates of flow through different parts of the sand are proportional to the permeabilities of the sand strata. As the differential pressure across the sand body is decreased and becomes extremely small, the molecular forces assume paramount importance and the liquids advance into the sand regions where the molecular forces are greatest.

The phenomenon of the capillarity of water driving oil out of the pores of reservoir sands was investigated also by Plummer and Woodward[27]. Cores of oil sands saturated with kerosene were immersed in a mixture of one-half kerosene and one-half water, with the dividing line between the two liquids at the half-way point on the sides of the cores. Pressure was applied on the surface of the kerosene-water mixture, and oil was produced through a hole drilled longitudinally through the center of the core. At first, the capillary action of the water on the oil drove oil out of the pores of the sand cores, and for a while more oil was produced than water. Later, after the capillary drive was complete, and thereafter so long as liquids were produced, the oil-water ratios did not vary. The oil-water ratios, however, differed for cores of different permeability—the finest grained, least permeable cores producing the greatest amount of water.

Investigations by Plummer, Hunter, and Timmerman[28] of the factors that affect the oil-water ratios of production from reservoir sands showed that the encroachment of water around a well did not depend entirely upon the pressure differential causing flow in the sand. In some fine-grained cores the percentage of water in the oil-water mixture was slightly less at high rates of flow than at low rates, and they attributed this difference to capillary action which is thought to be more effective in the sand immediately surrounding the well than farther back in the reservoir. According to Plummer and his co-workers capillarity also is probably more effective at low differential pressures of flow than at high pressure differences. The immediate implication is that water encroachment in fine sands cannot be controlled successfully by regulating the rate of production.

Edgewater Movement Rates

Water encroaching toward a well usually can be detected by observing the change in daily rate of production from the well. Normally, during the economic life of a well delivering clean oil, the daily rate of oil production decreases progressively, and the gas-oil ratio increases. As water approaches the well there usually is a temporary, sudden increase in oil production due to the local effect of a natural water drive, accompanied soon after by the production of a small amount of water. Thereafter, the water-to-oil ratio gradually increases until finally the well produces mostly water, showing that the oil-water interface has moved past the well. The approach of formation water also may be noted by an increase in the temperature of the oil produced. Field observations show that when a well starts to produce water, the temperature of the liquid at the top of the well increases. Reistle[29] attributes the increase in temperature to the fact that although the temperature of the water and oil in the sand is not greater than it was before, the entrance of water that has a specific heat about twice that of oil contains twice the thermal energy per pound. As the heat loss is not increased in proportion to the heat content, the temperature of the mixture at the wellhead is higher than when oil alone is being produced.

Temperatures of fluids at the wellheads of a number of wells in the 3,000-foot limestone pay of the Big Spring

field, Howard-Glasscock Counties, Tex., are reported by Carpenter and Hill[30] to have been 76° to 78° F. when the wells produced clean oil and to have increased gradually as water entered the well until those at the well-head were 84° to 90° F., when 67 to 89 percent of the fluid produced was water.

The rate of movement of encroaching edgewater is a function of the form of the geologic structure; the number of producing wells and their location on the structure; the well-spacing pattern; the rate of withdrawal of oil and gas from the reservoir; the rate of decline of reservoir pressure; the hydrostatic head of the water; the permeability of the oil-bearing sands; and the physio-chemical nature of the reservoir rock and fluids. However, only certain variables—rate of removal of reservoir fluids, rate of decline of reservoir pressure, well-spacing pattern, and number of producing wells—permit field control, although the others are related to them. Therefore, any results of measurements or observations relative to the variables over which no control can be exercised may have an important influence on field methods of water control. Gregory[31], in connection with his discussion of a paper by Nix, pointed out, for example, that a knowledge of reservoir pressure is especially important in planning systematic control of water encroachment and suggested that to minimize the "fingering-in" of advancing edgewater and subsequent entrapment of oil in reservoir sands, production practices should be such as to maintain uniform high pressures in the reservoir.

Several methods[32] have been used to determine the rate of movement of movement of underground waters. Dyes have been employed with some success to detect casing leaks and to ascertain whether water is migrating from one well to another. The water, of course, is recognized by its color after the dye has been added. Chlorides and other salts also have been suggested for detecting the movement of water between wells. The rate of edgewater encroachment in producing oil fields, however, usually is estimated by noting the time at which water appears successively in up-dip wells producing along a line perpendicular to the oil-water front. In determining the average rate of movement the oil-water front is assumed to parallel the strike of the oil-bearing stratum and to be moving in a crestward direction parallel to the dip. The rate is computed by dividing the number of feet of sand between two successive up-dip wells by the time elapsed between water occurrence in each.

Nowels and Dewees[33] report that edgewater advanced at the rate of 162 feet per year (0.44 foot per day) in the Salt Creek field, Wyo. Ambrose[34] estimated that the rate of water encroachment in the Coalinga field, Calif., from 1908 to 1912, was 400 feet per year (1.1 feet per day) and 200 feet per year (0.55 foot per day) on the average, from 1912 to 1918. Apparently voluntary curtailment of production and natural decline in oil production has retarded the rate of advance of edgewater in the Coalinga field as may be deduced from a more recent report by Uren[35] in which he stated that the average rate of advance of edgewater is 150 feet per year or 0.41 foot per day.

Considerably faster rates of edgewater encroachment in oil sands than those noted by Ambrose and Uren in the Coalinga field, have come to the attention of McConnell[36], who reported that in certain areas (presumably in the San Joaquin Valley, California) edgewater was found to be moving at the rate of 500 to 1,000 feet per year (1.37 to 2.74 per day). This rapid movement of edgewater, however, was markedly retarded by the application of back-pressure on up-dip wells.

From their study of the rate of movement of water into the oil-producing sand in the East Texas field, Texas, Nye and Reistle[37] computed that in 1933, the average **vertical** movement of water was 1/8- to 1/10-inch per day or approximately 3 feet vertically per year. Due to the low dip of the reservoir sand in the East Texas field, the lateral movement of edgewater, according to Cheney[38], was at the rate of 0.15 mile (792 feet) per year or 2.17 feet per day.

Hoots and Herold[39] expressed the opinion that the rate of encroachment of water in particular fields has not been ascertained with any degree of accuracy but that available data seem to indicate that 10 to 50 feet per year (0.27 to 0.137 foot per day) at the point on the edge of the pool nearest the center of mass production constitutes a reasonable expectation for most fields.

Whether or not the rates of advance of water found to be most efficient in artificial water-flooding operations in Pennsylvania can be taken as criteria of what might obtain in natural water-drive operations elsewhere can only be surmised. It is important to note, however, that in every case the rate of water movement considered most efficient in flushing oil out of sands in the Bradford field, Pennsylvania—80 feet per year year (0.22 foot per day) reported by Brewster[40], 72 feet per year (0.20 foot per day) as stated by Stephenson and Grettum[41], 35 feet per year (0.096 foot per day) as reported by Uren[42], and 12 to 20 feet per year (0.033 to 0.055 foot per day) as computed by James[43], is less than those in fields where edgewater is moving into the oil sands. The high rates at which edgewater naturally advances in oil sands probably is one very important reason why oil-recovery efficiencies in general are low.

That the efficiency of displacement of oil by water is a function of the rate at which water enters a saturated oil sand was demonstrated qualitatively by Uren[44] in experiments in glass tubes filled with unconsolidated, oil-saturated sand of different sand-grain sizes packed to approximately the same porosity. The experiments showed that the efficiency of extraction of oil by water was considerably greater when the water advanced slowly than at more rapid rates. The relative difference in quantitative terms was not published, but the data indicate that a greater percentage of oil was recovered when the rate of advance of water was approximately 61 feet per year (0.167 foot per day) than when the rate of advance was 244 feet per year or approximately 0.67 foot per day.

In studying the variables that effected an optimum rate of movement of the oil-water interface in reservoir sands, laboratory investigations by Bartell and Osterhof[45] and Bartell and Miller[46] showed that a definite time interval was required for water to displace oil from the surface of silica.

Although the results of Barnes'[47] experiments do not substantiate entirely the findings of Bartell and Osterhof, the deficient displacement of oil by water may be attributed to the apparently high velocities used by Barnes.

When the importance of the rate of water encroachment as a factor affecting oil-recovery efficiencies is considered, it is somewhat surprising that so little is known about what is an efficient rate of water advance. The most plausible conclusion that can be drawn from data available for study seems to indicate that in most fields where oil is underlain by water the rate of withdrawal of oil exceeds the rate at which water enters the oil sand. By inference, therefore, one may assume that some oil which might be recovered under slower rates of withdrawal remains entrapped by water in the reservoir sands. The fact that production of oil from reservoirs might be at an uneconomic rate when balanced exactly against rate of influx of water is appreciated. Nevertheless the possibility of recovering additional oil from some sands at a profitable, though somewhat slower rate than in effect in many fields should not be dismissed without serious consideration.

Development Program For Increasing Oil Recovery by Controlling Edgewater Encroachment

No single set of specifications can be drawn for developing all types of oil

reservoirs so that the maximum amount of recoverable oil can be withdrawn from the sands. The peculiar characteristics of each reservoir, the nature of the reservoir rocks (as well as their texture and bedding), and the character of the oil and gas and the pressure under which they exist in different reservoirs are but a few of the variables that preclude identical exploitation of all reservoirs.

Perhaps the most frequently mentioned program of oil-field development advanced in recent years by engineers as being nearly ideal from the standpoint of oil recovery and production costs relates to the development of anticlinal-type reservoirs having a gas cap above the oil accumulation and water under hydrostatic pressure below it. Essentially, the plan is to drill one or several gas-injection wells into the gas cap and to locate all producing wells so as to penetrate the oil zone a short distance down the dip from the gas-oil contact. By returning all or most of the gas produced with the oil to the reservoir through the wells drilled into the gas-cap area and by regulating oil-withdrawal rates so that reservoir pressures will be maintained at or near their original intensity, oil production and gas return can be balanced in such a way that the gas-oil contact will remain stationary, or nearly so, and only the oil-water contact will move. Thus, oil recovery does not depend upon the action of gas in driving oil out of the pore spaces in the sand but is contingent upon the superior flushing action of the encroaching edgewater driving oil up the dip of the structure to the producing wells.

Unfortunately, conditions of surface ownership of oil structures usually prevent carrying out such an idealized program as has just been stated. If there were only one owner or one management of every oil pool, a program such as outlined would prove advantageous, but where ownership of oil pools is divided among many different interests, cooperation leading toward unit operation is beset with many difficulties. Unit operation of oil pools in the United States, based as it must be on voluntary cooperation, so far has been more a theoretical goal toward which the industry might strive to advantage than a practical achievement. Nevertheless, as has been proved in some fields where voluntary cooperation has been effective, the industry could gain immeasurable advantages in greater oil recovery and lower productions costs by putting into practice some or all of the fundamental producing principles upon which unit operation is based.

For example, in a field under hydraulic control with a reservoir pressure greater than the gas-saturation pressure of the oil, the ideal producing method would be to extract the oil and gas only as rapidly as water displaces the oil in the pores of the producing sand. Under these conditions the reservoir pressure would be maintained above the gas-saturation pressure of the oil, thereby preventing gas from coming out of solution in the oil and dispersing occluded gas bubbles throughout the liquid-oil phase. If it were possible to operate a reservoir by this method, there would be in effect, a single-phase two-liquid (oil with gas in solution, and water) flow system. The quantity of oil recovered ultimately, even under the ideal conditions discussed, would depend largely on the completeness of the removal of oil from the surfaces of the mineral components of the reservoir sand and the efficiency of the removal of the oil held in the capillary spaces by the natural water drive.

Ideal operating procedures have been summarized briefly to point out that regardless of the practice exercised in the field, both rate of oil production and ultimate recovery depend vitally on the conditions under which edgewater encroaches into the oil-bearing part of the reservoir. In general, engineers have advocated that efficient water control may be best attained by governing the back pressures applied on the oil sand and by restraining rates of production from various wells, especially "edge" wells. These practices should be followed early in the producing life of fields because premature water encroachment may cause irreparable damage. In short, improperly controlled encroaching water has a deleterious effect on oil-recovery efficiencies and production costs that cannot be emphasized too strongly and should not be tolerated by operators who wish to proceed on a scientific basis.

In a report on the Cushing field, Oklahoma, for example, Wardwell, Brandenthaler, Williams, and Van Dall[46] pointed out that the rapid decline of oil production in the northern part of the field was due not only to wasteful depletion of the natural pressure in the sand but in part to early migration of water into the oil-bearing formation. During the early stages of development of the northern part of the Cushing field, engineers and operators did not fully recognize the function of edgewater in the production of oil and consequently failed to guard against erratic and uncontrolled invasion of water into the oil-bearing strata.

Wilde[49] demonstrated the detriment to oil recovery of rapid encroachment of edgewater experimentally in glass-front tanks containing model oil formations of sand and clay, similar to the equipment used by Mills (see footnotes 12, 13, and 14). The experiments showed that, at high rates of production, the rapid advance of edgewater and the wasting of the energy in the free-gas area above the oil permitted recovery of only 11.3 percent of the oil originally in the sand. In a supplementary experiment, where the gas was conserved in the sand but oil was produced at such a rapid rate that inefficient use was made of the water drive, only 22 percent of the oil was recovered. On the other hand, the experiment designed to illustrate the effect on oil recovery of a slow production rate with the edgewater advancing evenly not only showed no tendency of water coning toward the producing well but resulted in a recovery of 51 percent of the oil in the reservoir. Doubtless, some of the recovered oil was forced toward the producing well by the expansion of gas in the gas-cap area, but it is believed that the uniform advance of edgewater was responsible for the major portion of the oil produced.

The tendency of water to advance rapidly up the dip of the structure to wells producing at high rates, to form cones under those wells underlain by water, and eventually to prevent the entrance of oil to the well is appreciated by most petroleum engineers and operators. Nevertheless, the "taking of potentials" by allowing wells to flow "wide open" or pumping them at very rapid rates still is an accepted practice today in many oil-producing areas. If all operators would realize fully the damaging effect of such practice on future recovery of oil from the sands, it is probable that the desire to get high potentials at the risk of damaging the sands by water would no longer prevail.

Conclusion

This paper attempts to point out the importance of controlling the rate and manner of movement of edgewater in reservoir sands as it affects oil-recovery efficiencies and production costs. Some of the literature relating to movement of water into oil sands has been reviewed to indicate the present trend of thought and to show the need for additional research on the problem of increasing recovery efficiencies by more efficient utilization of the energy in the water underlying the oil in the majority of reservoirs.

The study suggests that further research of the conditions that affect the oil-recovery of an oil-water interface moving slowly through an oil sand would be of prime importance from the viewpoint of the operator. Doubtless, oil-recovery efficiencies that result from a slowly moving oil-water interface are a function of many variables. If these variables can be expressed in terms of

velocity for the purpose of pointing out the optimum velocity of movement of the oil-water interface for a given set of reservoir conditions, they will have practical application to field operation. For example, if the properties of the oil, edgewater, and reservoir formation are known, an optimum rate of water encroachment might be predicted that could be maintained by applying back pressure on the producing strata or otherwise controlling the rate of fluid withdrawal from the reservoir.

The discussion has been limited to sands filled with liquid, or in other words, to reservoirs in which the pore spaces in the sand below the oil-water interface are filled with water and those above are filled with oil[50]. This condition existed in fields such as the East Texas, where the oil was undersaturated with gas and at certain production rates moved through the sands toward wells by hydrostatic pressure and as a result of the expansion of the water in the extraneous part of the reservoir. Actually, then, in reservoirs exemplified by those of East Texas, the problem of more efficient oil recovery becomes, in a large measure, a study that involves the flow of a slowly moving oil-water interface through the sands. The problem is much the same in fields where the reservoirs contain free gas if the sand immediately above the oil-water interface is filled with oil under a pressure higher than that of gas saturation.

A different type of problem—one very similar to that manifest in fields under secondary recovery by artificial water drive—is presented if the sand above the edgewater line or gas and oil-water interface is filled with a mixture of oil and gas. This condition exists in reservoirs where oil and gas are produced from wells at such rates that reservoir pressures have decreased to less than the pressure at which gas remains in solution in the oil. Probably all commercial (economic) rates of withdrawal of oil and gas from reservoirs result in some decline in reservoir pressure. The production of oil and gas in volumes that greatly exceed the volume replacement by water and the consequent excessive lowering of reservoir pressures, however, are not conducive to efficient recovery of oil and gas, and such practices should be condemned.

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[1]Reprinted from Bureau of Mines Report of Investigations 3392.

[2]Junior petroleum engineer, Bureau of Mines, San Francisco, Calif.

[3]Senior petroleum engineer, Bureau of Mines, San Francisco, Calif.

[4]Millikan, C. V., Geological Application of Bottom-Hole Pressures: Bulletin Am. Assoc. Petrol. Geol. vol. 16, No. 9, September, 1932, p. 900.

[5]Nye, G. L., and Reistle, C. E., Jr., Recent Changes in Reservoir Pressure Conditions in the East Texas Field: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1934, p. 82.

[6]Reistle, C. E., Jr., East Texas Production: Oil Weekly, Feb. 26, 1934, p. 14.

[7]McConnell, P. C., Discussion of paper "Effect of Edgewater on Oil Recovery" by H. H. Wright: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1931, p. 176.

[8]Wright, H. H., Effect of Edgewater on the Recovery of Oil: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1931, p. 168.

[9]Wilhelm, V. H., Davis, E. L., and Clark, W. A., Characteristics of Edgewater Encroachment in California Oil Fields: Min. and Met. vol. 14, October, 1933, p. 425.

[10]Swensrud, S. A., Petroleum Industry-Economics: Min. and Met., vol. 18, January, 1937, p. 32.

[11]Moore, T. V., Discussion of paper "Selective Wetting of Reservoir Rock and Its Relation to Oil Production" by Allen D. Garrison: Am. Petrol. Inst., Drilling and Production Practice, 1935, p. 135.

[12]Mills, R. Van A., Natural Gas as a Factor in Oil Migration and Accumulation in the Vicinity of Faults: Rept. of Investigations 2421, Bureau of Mines, 1922.

[13]Mills, R. Van A., Subsurface Relationships in Oil and Gas Fields: Econ. Geol., vol. 15, No. 5, July-August, 1920, p. 398.

[14]Mills, R. Van A., Relations of Texture and Bedding to the Movements of Oil and Water Through Sand: Econ. Geol., vol. 16, No. 2, March, 1921, p. 124.

[15]Dodd, Harold V., Some Preliminary Experiments on the Migration of Oil up Low-Angle Dips: Econ. Geol., vol. 17, No. 4, June-July, 1922, p. 274.

[16]Dodd probably meant interfacial tension.

[17]Skirvin, Orren W., Experimental Study of the Invasion of Oil into a Water-Wet Sand: Econ. Geol., vol. 17, No. 6, September, 1922, p. 461.

[18]Bartell, F. E., and Osterhof, H. J., Determination of the Wettability of a Solid by a Liquid: Ind. Eng. Chem., Vol. 19, No. 11, November, 1927.

[19]For a more complete discussion of interfacial tension equilibria see "Certain Interfacial Tension Equilibria Important in Flotation" by Will H. Coghill and Carl O. Anderson, Tech. Paper 262, Bureau of Mines, 1923, 55 pp.

[20]Barnes, K. B., Preliminary Experiments in Oil Recovery: Pennsylvania State College Mineral Experiment Station Bull. 11, 1932, p. 71.

[21]Garrison, Allen D., Selective Wetting of Reservoir Rocks and Its Relation to Oil Production: Drilling and Production Practice, 1935, Am. Petrol. Inst., p. 130.

[22]Moore, T. V., work cited in footnote 11 (p. 4).

[23]Wyckoff, R. D., Discussion of paper 'Selective Wetting of Reservoir Rock and its Relation to Oil Production" by Allen D. Garrison: Drilling and Production Practice, 1935, Am. Petrol. Inst., p. 139.

[24]Nutting, P. G., Movements of Fluids in Porous Solids: Oil and Gas Jour., Vol. 25, No. 31, Dec. 23, 1926, p. 26.

[25]Uren, L. C., Increasing Oil Recovery by Flooding: Nat. Petrol. News, Aug. 3, 1927, p. 54.

[26]Bartell, F. E., and Miller, F. L., Degree of Wetting of Silica by Crude Petroleum Oils: Ind. Eng. Chem., July, 1928, p. 742.

[27]Plummer, F. B., and Woodward, J. S., Experiments on Flow of Fluids Through Sands: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1937, p. 120.

[28]Plummer, F. B., Hunter, J. C., Jr., and Timmerman, E. H., Flow of Mixtures of Oil and Water Through Sand: Oil and Gas. Jour., Vol. 35, No. 47, Apr. 8, 1937, p. 42.

[29]Reistle, C. E., Jr., Paraffin and Congealing-Oil Problems: Bull. 348, Bureau of Mines, 1932, p. 34.

[30]Carpenter, Charles B., and Hill, H. B., Petroleum Engineering Report, Big Spring Field and other fields in West Texas and Southeastern New Mexico: Rept. of Investigations 3316, Bureau of Mines, 1936, p. 69.

[31]Gregory, P. P., Discussion of paper, "Determination and Application of Depth Pressures in the Yates Field," by Dale Nix: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1932, p. 353.

[32]Ambrose, A. W., Underground Conditions in Oil Fields: Bull. 195, Bureau of Mines, 1921, pp. 113, 118.

[33]Nowels, K. B., and Dewees, E. J., Petroleum Engineering in the Lance Creek Field, Niobrara County, Wyo.: Bureau of Mines, 1926.

[34]Ambrose, A. W., Work cited in footnote 32, (p. 12.) p. 154.

[35]Uren, L. C., The Elements of the Oil-Well Spacing Problem: Bull. Am. Assoc. Petrol. Geol., Vol. 9, No. 2, March-April, 1925, p. 201.

[36]McConnell, P. C., Discussion of paper, "Effect of Edgewater on the Recovery of Oil," by H. H. Wright: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1931, p. 176.

[37]Nye, C. L., and Reistle, C. E., Jr., Recent Changes in Reservoir Conditions in the East Texas Field: Petroleum Development and Technology, 1934, Am. Inst. Min. and Met. Engr., p. 77.

[38]Cheney, M. G., Economic Spacing of Oil Wells: Bull. Am. Assoc. Petrol. Geol., Vol. 19, No. 6, June, 1935, p. 876.

[39]Hoots, Harold W., and Herold, Stanley G., Natural-Gas Resources of California, Geology of Natural Gas—A Symposium: Am. Assoc. Petrol. Geol., 1935, p. 122.

[40]Brewster, F. M., Discussion of paper, "Factors Influencing the Recovery of Petroleum from Unconsolidated Sands by Water-flooding," L. C. Uren: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1927, p. 335.

[41]Stephenson, E. A., and Grettum, I. G., Valuation of Flood Oil Properties: Am. Inst. Min. and Met. Eng., Tech. Pub. 323, 1930, p. 17.

[42]Uren, L. C., Work cited in footnote 35, p. 201.

[43]James, H. G., Bradford Still Much Alive: Petrol. Age, Nov. 1, 1923, p. 18.

[44]Uren, L. C., and Fahmy, E. H., Factors Influencing the Recovery of Petroleum from Unconsolidated Sands by Water-Flooding: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology, 1927, p. 318.

[45]Bartell, F. E., and Osterhof, H. J., Work cited in footnote 18, (p. 7).

[46]Bartell, F. E., and Miller, F. L., Work cited in footnote 26, (p. 10) p. 74.

[47]Barnes, K. B., Work cited in footnote 20, (p. 8).

[48]Wardwell, D. P., Brandenthaler, R. R., Williams, W. L., and Van Dall, John, Water Problems in the Northern Part of the Cushing Field, Creek County, Oklahoma: Cooperative Report, Bureau of Mines and State of Oklahoma, 1927, p. 64.

[49]Wilde, H. D., Jr., The Value of Gas Conservation and Efficient Use of a Natural Water-Drive as Demonstrated by Laboratory Models: Am. Petrol. Inst., Production Bull. 210, 1932, p. 4.

[50]The possibility of the presence of so-called connate or "residual" water is appreciated but not considered.

Broderick & Bascom Rope Co., in the bulletin announcing their purchase of the Murray Safety Sling Co., Inc., 33 Water St., Pittsburgh, Pa., illustrate a number of striking examples of the use of the Murray Plaited Safety Slings in industries where a flexible sling of large capacity is needed. The bulletin says that the Murray Safety Slings will be improved further by the use of "Yellow Strand" Wire Rope.

The Jeffrey Manufacturing Co., Columbus, Ohio, in their recently issued Bulletin 678-A, describe their line of chains for oil well service ranging from ordinary shallow drilling to the fastest and deepest drilling. On the back cover of the bulletin is shown the Jeffrey "Blue Streak" Shale Shaker or Mud Screen, which is said to have a number of valuable new features.

Bulk petroleum shipments from Los Angeles Harbor during the week ended Sept. 10 totaled 961,117 bbls., a slight drop under the total for the previous week.

According to a recent survey conducted by Fortune Magazine, the gasoline tax is the third most unpopular tax in the United States.

Exports of gasoline and crude oil continue to mount with indications that the latter may establish a new high record this year. For the first seven months off-shore shipments of gasoline totaled 28,194,000, an increase of 39 per cent compared with the similar period of 1937.

Field Development

Los Angeles Basin

Texas Co. Extends Harbor City Area

Completing Oakley No. 1 flowing 360 bbls., The Texas Co. extended the Harbor City area of the Torrance field more than a quarter of a mile to the east. Located south of Lomita Blvd. and east of Vermont Ave., the well was started as a virtual wildcat, but topped the D & B zone at 5050 ft., slightly higher than the discovery well. Core recovery from the top of the horizon to 5150 ft. consisted of shale with thin streaks of oil sand, but from there to 5191 ft. was solid oil sand. The last six feet to bottom at 5197 ft. was all shale. Casing was cemented over the zone and after landing a perforated liner, the well was swabbed in flowing 30.6 gravity oil cutting 0.8%.

Following a favorable formation test in the Oakley prior to its completion, Richfield Oil Corp. and Sierra Trading Co. spudded their easterly outpost wells. Richfield's Spring No. 1, at "Q" and Eudora Sts., is now below 4000 ft., while Sierra's Sierra-Spring No. 1 is approximately half that depth.

Of great importance to future southward development is the deep test to be made in D & B Oil Co., Dawn No. 2, located at 255th St. and Petroleum. After finding only a few showings in the Del Amo zone, the well was suspended at 5411 ft., but is now being conditioned to deepen as a joint project of several operators holding acreage in the vicinity.

So far, at least, the Torrance Extension seems destined to produce no large wells, none having yet sustained a flow of 500 bbls. for more than a very short period.

Silverado Oil Co. bottomed its No. 1 well at 5265 ft. and with 155 ft. of zone open, completed with initial production gauging 250 bbls. of clean oil.

Ring Oil Co. finished its Hawkins No. 1 in record time, bottoming at 5285 ft. and swabbing in with an initial rate of 620 bbls. of 29 gravity oil cutting 4%.

On the Poggi lease, north of Lomita Blvd. and west of Vermont Ave., General Petroleum Corp. completed No. 9 for 317 bbls. cutting 10% after plugging bottom from 5426 ft. to 5190 ft. Only 70 ft. is open below the shoe of the water string. Equipment was moved to No. 10, now drilling below 1200 ft.

J. L. O'Donnell is returning No. 43 to production after landing a liner on bottom, 5346 ft., and cementing through perforations at 5150 ft. On a test with the hole open below the shoe of the water string at 5146 ft., the well flowed 184 bbls. in eight hours with a 35% cut.

Several wells are listed for early completion; among them California Star Oil Co. Anderson Comm. No. 1, Macson Oil Co. No. 1589-1, and Padran Oil Corp. No. 1.

As more wells are drilled, more and more is being learned of the general picture. Recent electrical log studies indicate definitely that the D & B zone corresponds with the Del Amo zone of the Lomita sector and that the Torrance Main zone is stratigraphically the same as the Terminal zone of the Wilmington field. There is evidence to believe that the Ford zone may correlate with the Del Amo.

Potrero Well Cores Good Oil Sand

Basin Oil Co., which completed its Potrero Country Club No. 1 last spring, flowing 500 bbls. of high gravity oil, is coring good oil sand in its second well below 4700 ft. Although sufficient sand has already been uncovered to assure a good well, rumor has it that the company may carry No. 2 on down to prospect for deeper horizons.

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
Bellflower	Clayton, Geo. L., Scott	1	32, 3-12	6897	Idle
Castaic	Royal Land Corp.	1	8, 4-17	1085	Cleaning out
La Mirada	DHB Oil Co., Heath	1	34, 3-11	5750	Drilling
	John McKeon & Assoc. Carmenita	1	21, 3-11	8350	Idle
Newhall	Continental Oil Co., Newhall	1	20, 4-17		Grade
	National Pet. Corp.	1	27, 4-16	2775	Abandoned
	Newhall Drlg. Asso., Needham	4	13, 3-16	3505	Prep. to deepen
	Palmluck Oil Co.	1	23, 3-16		Rig
Palmdale	Antelope Valley Pet.	1	17, 6-12	50	Idle
Palos Verdes	Gene McLaren	1	27, 4-14	3992	Idle
	Rolling Hills Pet.	1	27, 4-14	5100	Idle
Pico	British Am. O. P. Co.	1	12, 3-12	5775	Drilling
San Fernando	Tide Water Assoc., Porter	1	27, 3-16	4225	Prep. to deepen
Santa Monica	Texas Co., A.-S.	1	9, 2-15		Rigging up
San Pedro	Grady, R. T.	1	23, 5-14		Rig
	Hogan Pet. Co., Burkhead	1	7, 5-13	2600	Drilling
Whittier	Langstaff, Geo. W., Iliff	1	8, 2-11	2250	Idle
	Orange County				
Bolsa Chica	New Fields Oil Co.	1	16, 5-11	250	Drilling
Costa Mesa	A. V. Oil & Gas Co.	1	16, 6-10	4634	Redrilling
	San Bernardino				
Chino	So. Counties Pet. & Drlg. Co.	1	26, 2-8	1900	Drilling
	San Diego County				
Carlsbad	Dauphin Dev. Co.	1	16, 12-4	525	Drilling

SURWEL

GYROSCOPIC CLINOGRAPH

Sets Another Remarkable Record

The Superior Oil Company's deep well at Rio Bravo, California, was double surveyed when at a depth of 11,322 feet with the "SURWEL" Gyroscopic Clinograph attached to the drill pipe making the round trip in 5½ hours.

The Superior Oil—Geisenger No. 2 Rio Bravo, Kern Co., California

FROM THE LOG

In-run started at.....9h 28m 00sec.
Bottom reached at.....11h 41m 00sec.
Out-run completed at....2h 55m 00sec.
Total time for two surveys 5h 27m 00sec.
Closure between In- and Out-run .....6.1'
Maximum temperature recorded.218°F.

Records taken every 45 feet.

●

Sperry-Sun congratulates The Superior Oil Company and their California Staff for successfully completing one of the fastest round trips ever made at such depth—a splendid performance!

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(U. S. Patents 1,124,068; 1,812,994; 1,898,473; 1,959,141; 1,960,038; 2,006,556; 2,012,138; 2,012,152; 2,012,455; 2,012,456 and others pending)

Signal Hill Test Sidetracks Fish

Failing to recover drill pipe lost in its 7525 ft. Signal Hill deep test, De Soto Oil Co. has resorted to sidetracking to avoid a long and costly fishing job. The well is just arriving at the point where it becomes interesting and from now on will be the most important well in the Los Angeles Basin.

Massey & Associates are installing machinery in a rig erected by them early this year at the intersection of 29th St. and Walnut Ave. The well is expected to be carried to the Alamitos zone.

In the northwest extension area, Caminol Co., Ltd., is drilling Dominguez No. 2-10 below 1800 ft. The well adjoins the Hilldon Oil Co. well which discovered the 7600 ft. Miocene zone. A. S. Johnston Drilling Co. has a derrick built for well No. 35 east of the Pacific Electric Railroad.

Huntington Beach Starts Tideland Development

Southwest Exploration Co., recently awarded a lease on the state owned tidelands at Huntington Beach, has derricks up for the first two of approximately 80 wells to be ultimately drilled. Surface sites of State Nos. 1 and 2 are on the Standard Oil Co. "B" lease and are adjoining the No. 66 well. All wells will be drilled from upland locations and whipstocked under the ocean floor.

Southwest Exploration Co. is a new operating unit formed by Signal Oil & Gas Co. and Hancock Oil Co. for the express purpose of developing the tidelands.

East Basin Field Activity Is Small

Activity, generally, is light in the east Basin fields. At Richfield, Goodrich Oil Co. has spudded its No. 1 well near the intersection of Buena Vista St. and Richfield Road and the Shell Oil Co. is drilling a core hole on the Harriman property after abandoning Kiker No. 1 at 3023 ft.

In the Brea fields, Shell Oil has a rig built for Orange No. 20 and Brea Canyon Oil Co. is preparing to drill well No. 49.

Graham & Loftus Oil Co. is the only active operator in East Coyote, having just spudded in Perkins No. 2. Yorba Linda is inactive save for a few clean out jobs.

Bastanchury No. 3, drilling below 5800 ft., is Standard's only working project in West Coyote.

Ford Zone Play Looms at Wilmington

Completion of several town lot wells in the Ford zone with yields up to 700 bbls. a day will probably cause a mild deep drilling boom in the already well developed portion of the Wilmington field.

Largest of the new completions is Southern California Petroleum Co.'s "W" No. 1, located at the corner of "G" and Sanford streets, which came in flowing at the rate of 750 bbls. a day of 29.7 gravity clean oil. Deepened from the Ranger zone, the hole was carried to 5695 ft. and finished with 6⅝ in. casing with the lower 85 ft. perforated, landed on bottom. After cementing at 5607 ft., this string was perforated in the hole by the gun method from 5202 to 5342 ft. and from 5445 to 5502 ft. Using a 40/64 in. bean, production has been restricted to 330 bbls.

Another good well was completed in the Ford zone by Royalty Service Co., drilling contractors for Sunray Oil Co. Nelson No. A-7, situated near the intersection of "D" St. and Pioneer, was bottomed at 5627 ft., and with perforations open from 5090 to 5500 ft. and from 5535 to 5625 ft., the well was brought in flowing clean, 30 gravity oil at the rate of 400 bbls. a day.

Because of its high gravity and its freedom from sulphur, this oil is more easily marketed than the lower grade product of the less prolific Ranger zone, it is to be expected, therefore, that other operators will deepen or drill new Ford zone wells.

Union Pacific Railroad completed two nice wells on its large, centrally located holdings. South of the connecting channel and west of Ford Ave., No. 82 initialled 507 bbls. from the Ranger and Upper Terminal zones. Total depth is 3527 ft. No. 92, located on Terminal Island east of Ford Ave., was completed as a three zone producer from 4042 ft., establishing a potential of 3300 bbls. a day of 27.8 gravity oil cutting 0.1%.

At the corner of First St. and Riverside Ave. in the Long Beach Harbor sector, Bankline Oil Co. completed U. P. No. 11 under wraps in the Ranger zone flowing 200 bbls. of 16.9 gravity oil through a 14/64 in. bean.

On the Seaside School Community lease, in the harbor district, Superior Oil finished No. 1 in the Lower Terminal and Ranger zones flowing at a 675 bbl. rate.

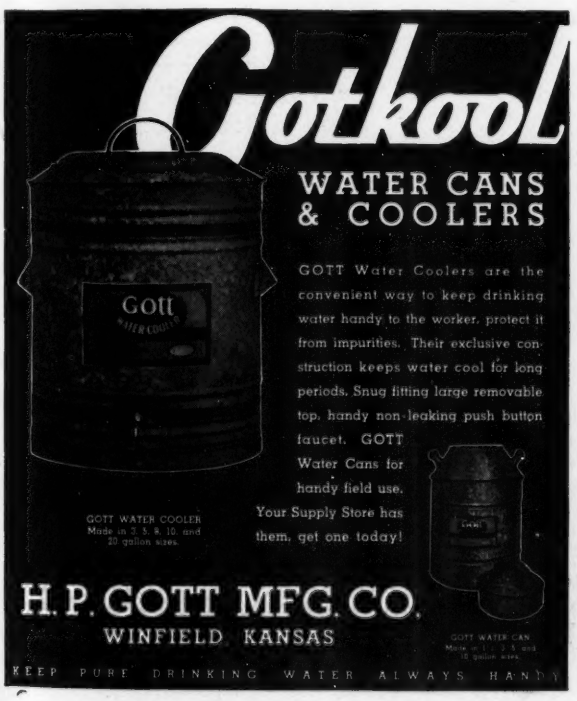
Two wells are being completed in the central Long Beach area, Independent Drilling Co. (Ivar Larson), Vosper No. 1 and General Petroleum's Harbor Comm. No. 19. The latter company is also preparing to bring in Flint No. 1 from the Ford zone in the Wilmington area.

Development of the Harbor channels has been held up indefinitely by failure of the city of Long Beach to effect a compromise with the Long Beach Dock & Terminal Co., which appears to have a valid claim to the mineral titles. No definite steps have yet been taken by the city to develop the tidelands, title to which was confirmed by the state supreme court.

Basin Wildcatting Shows Increase

Indicating a feeling of confidence within the industry, more exploratory wells are being drilled in the Los Angeles basin than at any time in recent years. Several have shown good possibilities but none at the present time appear on the verge of a major discovery.

Greatest interest has been shown in Tide Water Associated Oil Co.'s Porter No. 1 in Aliso Canyon, west of San Fernando, and in John McKeon & Associates, Carmenita No. 1 in the La Mirada area. The former well is preparing to deepen after a production test from 3800 to 4220 ft. resulted only in the recovery of a little wet oil. The McKeon well is temporarily idle as it flowed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salt water from the interval 7475-8350 ft. and the operators are considering the advisability of further work.

Most recent project to be announced is Richfield Oil Corp.'s Dominguez Estates No. 1, which will be drilled half a mile southeast of the tip of the old Dominguez field.

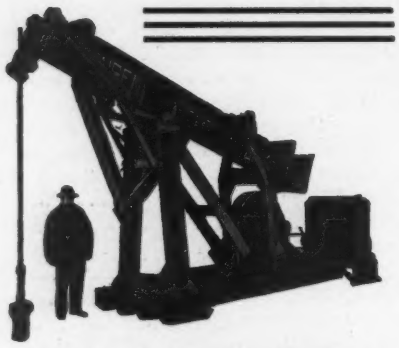
After overcoming many legal obstacles, The Texas Co. has finally spudded in its Anderson-Spring No. 1, the long awaited test of the Santa Monica area.

Two tests are active in the San Pedro district of Palos Verdes. Hogan Petroleum Co. is withholding all information on its Burkhard No. 1, but a recent drill pipe count placed the bottom at 2600 ft. Near Pt. Fermin, R. T. Grady has erected a derrick on Sepulveda property.

British American Oil Producing Co. resumed work on its Pico No. 1 between Montebello and Whittier and is deepening below 5898 ft. The company plans to carry the hole below 7000 ft. if necessary. Near the Whittier Heights cemetery, Security Land & Water Co. has suspended operations at about 2250 ft.

Two wells are prospecting in Orange county, both in areas already peppered with dry holes. On the Mesa back of Newport, A. V. Oil & Gas Co. is fighting mechanical trouble after making an unsuccessful production test from 4634 ft. while New Fields Oil Co. has just spudded at the intersection of Smeltzer and Bolsa Chica roads between Seal Beach and Huntington Beach.

In the Newhall area, Continental Oil Co. is preparing to drill a core hole in sec. 20, 4-17, and Newhall Drilling Associates are making ready to deepen the old Southern California Drilling Co., Needham No. 4 in sec. 13, 3-16.



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W. Montebello Activity Reaches New High

With 15 projects working, activity in the west Montebello extension has reached the highest point since its discovery by St. Helens Petroleum Co. in January of this year. Nine wells are drilling or testing in the sixth zone, one at least, apparently being destined to become a large, clean producer from below 6320 ft. This well, Union Oil Co., Howard & Smith No. 3, made a formation test from 6320 to 6385 ft. during which clean oil reached the surface in 40 minutes and 3700 ft. of oil was recovered in the drill pipe. No salt water was in evidence.

Two small wells were completed, St. Helens obtaining 180 bbls. a day from Monterey No. 28, and V-8 Oil Co. netting an estimated 350 bbls. from M. B. No. 1. Both were bottomed in the sixth zone.

Standard Oil Co. has two wells approaching completion, Harvey No. 3 testing casing cemented at 6151 ft. and Braun No. 3 located on the Benedictine monestary property, drilling below 6350 ft.

Montebello Wesco, Inc., Montebello No. 1 is plugging bottom after a test at 6275 ft. showed excessive water. McVicar & Rood and Herley-Kelley are deepening Manz No. 2 and Burke No. 1 respectively.

Union Oil Co. is preparing to complete Paul Howard No. 1 and is rigging a pump on Wilcox No. 2.

Activity at New Low In Torrance-Lomita

Striking a new low in its abrupt decline in activity, the Torrance-Lomita area reported only five completions during the past two weeks. The number of active drillers dropped to eight, while the total of those completing, or in many cases just attempting to complete, jumped to 15.

Of the five successfully completed, three were unusually large; J. E. P. Oil Co. (Pettijohn) No. 1 flowing 600 bbls., Kovell Oil Co. No. 3 flowing 640 bbls. and Standard Oil Co. Marble No. 2-7 550 bbls. Favorably located structurally, these wells were all free of water. Less fortunate were Pacific Western Oil Co. and Del Amo Oil Corp., which completed Marble No. 4 and Denbo No. 1, respectively, as small pumpers.

Star Petroleum Co.'s holdout well, Patton No. 1, on 236th St., east of Narbonne, is rumored to be pumping 300 bbls. of oil cutting 10% after a reperforating job. Other estimates place the net production as low as 50 bbls.

On the high point near the intersection of 238th St. and Eshelman, Sunny State Oil Co. is preparing to test 300 ft. of formation cored below the shoe of the 7 in. casing at 4840 ft. While drilling, a drill pipe test was made of the interval 4840-4965 ft. which is said to have been very favorable.

Many wells attempting to complete are being plagued with water and mechanical troubles and a large percentage will doubtless join the growing number of indefinitely suspended projects.

Two Wells Limit O'Dea Zone at Rosecrans

Recent developments in the Rosecrans field indicate that the limits of the deep O'Dea sand will soon be outlined. Barnsdall Oil Co.'s Trust No. 6, located 1100 ft. north of Rosecrans Ave. and 175 ft. east of Figueroa St., found the zone faulted out, and was given up at 7775 ft. At the opposite corner of the field, Bankline Oil Co. found only a small portion of the zone and has plugged Kirby No. 1 to redrill. H. B. Oil Co., drilling at the southwest corner of Rosecrans and Figueroa, has set casing for a production test after electrically logging the hole to bottom at 7830 ft. Although oil sands were indicated at higher levels, the last 200 ft. only will be tested.

Only one well was completed, and that by the Union Oil Co. Rosecrans No. 25, near the intersection of Broadway and Rosecrans, was bottomed at 7438 ft. and turned to the tanks Oct. 2, flowing at the rate of 985 bbls., cutting 12%.

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San Joaquin Valley

Deep Wasco Pay Cored by Three

The next few weeks will, indeed, be an important period in the history of the deep Wasco field. Two Continental Oil Co. wells and one Standard are now in the zone and upon the results of these rests the future course of development.

Continental's KCL A-3-8, located north of the discovery well, KCL A-2-8, definitely located the top of the Wasco (Vedder) sand at 13,156 ft., and though it did not show up as well as in the first well, it will soon be tested.

A 5-in. liner, 2099 ft. in length, stuck and was cemented at 13,211 ft. and preparations are being made to test the open hole interval to bottom at 13,644 ft. If the well cannot be completed from this zone, the bottom will be plugged and the liner perforated below 13,156 ft.

In sec. 17, 27-24, Standard Oil Co., KCL 8-B-1 topped the zone at 13,025 ft. and is setting casing for a test.

Seaboard-Associated, KCL C-1, being drilled by Continental in sec. 26, 27-24, southeast of the discovery area group, found light cuts in the upper portion of the zone which was topped at 12,664 ft. An electrical log will be made when bottom reaches 13,100 ft.

As in the famous KCL A-2-8, the cores do not look very encouraging in any of these wells and it remains for production tests to show their capabilities. If the three obtain production, the area of the field will be large.

The fourth drilling well in the area, Standard's Mushrush No. 1 in sec. 7, 27-24, offsetting the discovery well, is making hole below 12,000 ft.

Jacalitos, Pure, Drop Fresno County Wildcats

Two of Fresno county's most important wildcats have recently been posted on the abandoned list.

Pure Oil Co. carried Southern Pacific Land Co. No. 1 to the unusual depth of 12,336 ft., where, in Cretaceous formation, it was abandoned with a fish in the hole. Nearly a year was consumed in the drilling of this well, several months having been lost in a difficult fishing and sidetracking job. Located in sec. 31, 18-17, north and east of Coalinga production, only a few gas showings were encountered.

Jacalitos Petroleum Co., headed by Dana Hogan, abandoned its Associated No. 1 at 7257 ft. Located on the Jacalitos in sec. 14, 21-15, the well was bottomed in Moreno after finding only gray sand in the Gatchell zone topped at 7018 ft.

Coalinga Tests Promise Little

Very little promise has yet been shown by any of the several wildcats now drilling in the Coalinga area of Fresno county.

Magnet Oil Co.'s vital Coalinga West Side test, Fearon No. 2 in sec. 18, 20-15, is standing idle at 4933 ft., having found the Gatchell member of the Eocene entirely absent. There is yet a possibility that the well may be taken down as a test of the Cretaceous.

In sec. 12, 21-14, Stuart Oil Co. is drilling Stuart No. 1 below 350 ft. with light equipment.

Shell Oil Co., Coast Range No. 21, using a light portable rig, is drilling in the Moreno siltstone below 1200 ft. This well seeks deeper production in the oil field in sec. 17, 19-15.

Near the north end of the Coalinga East Side field, Tide Water Associated Oil is drilling Fleishacker No. 57-1 below 5300 ft. in sec. 1, 19-15.

Dauphin Development Co.'s Waltham Valley test, Ragan No. 1, sec. 19, 21-14, was last reported at 3314 ft. in tough gray shale.

Cyrus Pierce, drilling Shorb No. 1 in sec. 16, 14-12 near Mendota, reports a depth of 850 ft.

Caminol-Bush Trico

Somewhat disappointing was the Vedder zone in the Trico deep test of The Caminol Co. and R. R. Bush Oil Co. in sec. 29, 25-24, northwest of the gas field. Below 9260 ft., 100 ft. of gray sand was cored, most of which gave a light cut, but though some gas was in evidence, the outlook for production from the interval is not considered too good. No judgment may be made until after an electrical log is taken and possibly until after a production test. In search of better showing, the hole is being deepened.

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
E. Coalinga	Pure Oil Co., SPL	1	31, 18-17	12336	Drilling
Clovis	Central Valley Oil Co.	1	1, 12-20	608	Idle
Jacalitos Hills	Jacalitos Pet. Co.	1	14, 21-15	7257	Abandoned
	Dauphin Dev., Ragan	1	30, 21-14	3281	Drilling
Mendota	Pierce, Cyrus, Shorb	1	16, 14-12	750	Drilling
Panoche Hills	Panoche Hills Oil Co.	3	12, 14-11	850	Drilling
	Kern County				
Belridge	General Pet. Corp., St. Helen	2	12, 28-20		Location
Buena Vista	Ohio Oil Co., KCL	A–8	32, 31-26	11186	Idle
		F–1	10, 31-25	8550	Drilling
Buttonwillow	Calif. Lands, Inc., Salisbury	1	7, 29-24	5300	Drilling
Canal	Shell Oil Co., KCL	B–87	4, 30-25	5075	Drilling
Devils Den	Gibson Oil Co., Alferitz	3	14, 25-18	1200	Drilling
	Goodrum, Geo., Baron	1	24, 25-18	1210	Idle
Dominion	Master Pet. Co., U.S.	1	34, 26-28	825	Idle
Edison	Johnson, G. W.	B-P 1	33, 29-30	1175	Drilling
Elk Hills	Richfield Oil Corp.	KCL-W 1	32, 30-25	8150	Drilling
	Renner & R.H.L. Oil Co.	1	27, 30-30	1600	Drilling
Famosa	Shell Oil Co.	KCL A-58-8	8, 27-26		Rig
Fruitvale	The Texas Co., C.W.L.	1	7, 29-27	10122	Redrilling
Grapevine	Hall-Baker Co., Reserve	33–2	33, 11-19	4615	Testing
	Petrol Corp., Reserve	33–5	33, 11-19	5250	Drilling
	Richfield Oil Corp.	KCL-1	28, 11-20	7236	Drilling
McFarland	White, C. C. Armstrong	2	9, 26-26		Rig
Poso Creek	Little & Gilstrap Keating	1	20, 27-27	2046	Testing
	Reynolds Oil Co.	1	20, 27-27	2855	Idle
Strand	Continental Oil Co.	E-1	17, 30-26	8575	Redrilling
Union Ave.	Richfield O. Corp.,Union Ave.	1	6, 30-28	6185	Drilling
	Kings County				
Alpaugh	Tri Counties Oil Co., Olson	1	10, 23-22	7769	Idle
Dudley Ridge	Falcon Oil & Gas Co.	1	24, 23-20	6500	Idle
Pyramid Hills	Pyramid Prod. Co.,Retherford	1	27, 24-18	3090	Idle
Kettleman	Temblor Oil Co., Bunting	1	25, 23-18	9138	Plug 7815—Idle
Tulare Lake	Irvine, Athalie	1	11, 24-20	2210	Idle
	Tulare County				
Alpaugh	Sullivan & Youngdahl	1	33, 23-23	2732	Idle
Ducor	Nelson & Davison	1	1, 24-27	1440	Idle
Trico	Caminol Co., A. O. G.	3	29, 24-24	9550	Drilling

Lost Hills Edge Test Cores Temblor Sands

Coring poor looking oil sand from 5937 to 5985 ft. in the upper Temblor zone and good oil sand, grading to poor, in the second horizon from 6014 to 6074 ft., California Lands, Inc., Occidental No. 1 became one of the most interesting of valley wildcats. Located in sec. 24, 26-20, approximately half a mile west of the limits of the Lost Hills field, no oil was expected to be found in these strata, the well being drilled as a test of the deeper zones productive at North Belridge. From 6074 ft., to last reported bottom of 6222 ft., formations have been alternate gray sands, shales and shells.

Shell Starting New Famosa Test

A well promising to be one of the most interesting of San Joaquin Valley wildcats is now being started by the Shell Oil Co. near Famosa. Derrick is up and drilling is scheduled to commence within a few days on the new test which is located in sec. 8, 27-26 and is known as KCL A58-8.

Geophysics is said to have furnished the data by which the location was chosen. In general, the area is on a prolongation of the Mountain View-Union Avenue-Fruitvale structural trend.

Buttonwillow Test Shuts Off Gas Sand

California Lands, Inc., Salisbury No. 1, deep test of the area south of the Buttonwillow gas field, encountered a high pressure gas sand at 4719 ft. which though only five feet in thickness, threatened for a time to cause a disastrous blow out. Only immediate increase of mud weight from 95 to 120 lbs. saved the well. After coring ahead to 5302 ft., 11¾-in. casing was cemented at 5297 ft., to eliminate the danger. Location of the well is the northeast corner of sec. 7, 29-24.

Tide Water May Drill Grapevine Wildcat

Although official announcement has not yet been made, persistent rumors from Bakersfield indicate that the next well in the Grapevine area will be drilled by Tide Water Associated Oil Co. in sec. 15, 11-19.

The Petrol Corp. is deepening Reserve-Petrol No. 33-5 in sec. 33, 11-19. Bottom was last reported in gray sand at 5225 ft. after coring the conglomerate zone at 4900 ft.

Hall-Baker Co. is cleaning out the old Reserve No. 33-2 in an attempt to obtain steady production.

Richfield Wildcats Attracting Interest

Three valley exploratory wells of the Richfield Oil Co. are among the most interesting now drilling.

Tupman-Western No. 1, located in sec. 32, 30-25 east of the old Elk Hills field, is below 8175 ft., and though the formation is withheld, reports of gas showings have been received.

The company's Wheeler Ridge edge test, KCL No. 1 in sec. 28, 11-20, at a recent date was down 7225 ft. and coring slickensided shale formation.

Making a deep test of the much drilled Union Avenue district southeast of Bakersfield, the No. 1 well in sec. 6, 30-28 is coring dark gray siltstone below 6175 ft. after topping the Santa Margarita at approximately 5200 ft. Many wells have been drilled in this vicinity since the Pacific Eastern Production Co. started the ball rolling in 1927. None however, went to the Vedder zone, goal of Richfield.

Western Gulf Recompletes Price-Stewart Fruitvale

Western Gulf Oil Co., discoverer and largest developer of Fruitvale, obtained a 160 bbl. clean, flowing well in the recompletion of Price-Stewart No. 4 in the Kernco sand at 3870 ft. Six and five eighths inch casing was cemented at 3770 ft. and the well finished with a four and three quarter inch liner.

The company is preparing to complete KCL B-39 in sec. 14, 29-27 after cementing 8⅝ in. casing at 3866 ft. over the upper Kernco sand.

Tidewater Guardian 66 Limits Gatchell Zone

Failure of Tide Water Associated Oil Co.'s Guardian No. 66 to find the Gatchell zone definitely limits extension of the Coalinga Eocene pool to the northwest. After coring the green sand, or glauconite marker, at 6275 ft., 30 ft. higher than Universal Consolidated's Leavitt-Hintze No. 1, the Tide Water well entered the dark gray siltstone which continued to 6855 ft., last reported bottom.

The well is located in sec. 12, 20-15, approximately 2000 ft. northwest of Petroleum Securities' big producer, Grimes No. 88-12C. This test, the Universal well, and Medford Oil Co., Goetz No. 1, all encountered the top of the Eocene higher than 6400 ft. but were doomed to disappointment, the Gatchell sand apparently pinching out at about that contour. The Medford project, located in sec. 10, 20-15, has plugged bottom from 6715 ft. to test showings at 6370 ft. near the top of the Eocene.

Next completion will be Standard Oil Co., No. 82-13C in sec. 13, an offset to the discovery well. The green sand was picked up at 6690 ft. and Gatchell sand at 6770 ft., making it for some unaccountable reason, structurally higher than its neighbor.

Soon to follow Standard is Superior Oil Co., which with characteristic speed is drilling Coalinga Fee No. 1 in sec. 7, 20-16. Having spudded in Sept. 23, the well had reached a depth of 6020 ft. on Oct. 4th. Superior has chosen locations for Coalinga Fee No. 2 and for Cagle

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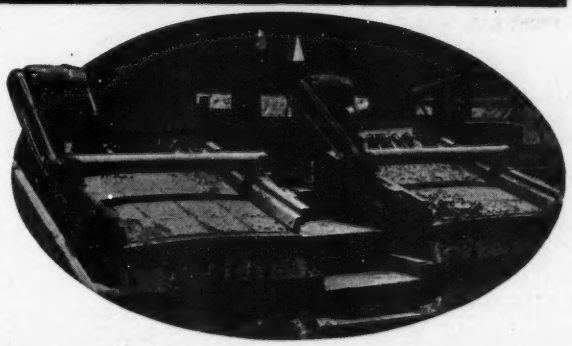

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No. 1, the latter in sec. 6 and practically a wildcat.

Petroleum Securities Co., which is disposing of much of its other holdings holdings to concentrate in the new field, has two strings of tools working. No. 88-7F in sec. 7, is drilling at shallow depths while No. 31-18F is below 3500 ft. The former is an offset to Superior Oil Co., Hight No. 1. Texas Co.'s Mohawk No. 19 is now idle after repeated attempts failed to obtain production from the depleted upper sand. Recent developments indicate the well to be definitely out of the Gatchell zone play.

Universal Consolidated Oil Co. tested showings in Leavitt-Hintze No. 1 at various points from bottom at 8108 ft. back to 6975 ft. in the Cretaceous and the green sand in the Eocene but found nothing of commercial importance. The project is standing idle with the last plug at 5270 ft.

Ohio Completes E-8 at Canal

With initial gauges registering a flow of 1750 bbls., Ohio Oil Co. completed KCL No. E-8 in the Canal field. The well, sixth producer for the company, is producing clean oil from the interval 8096-8294 ft. and is an offset to Shell's KCL A-2-13 and A-32-13. The latter company is drilling KCL A-43 in sec. 14, 30-25 below 7000 ft. and has recently completed No. A-45-14 flowing 2300 bbls., clean.

Standard Oil Co. is attempting to sidetrack a fish in its No. 1 well on the 80 acre Rio Bravo pump station site. Bottom of the hole is 7865 ft., very near the expected top of the oil sand.

Coastal District

El Capitan Well Held Phenomenal

Another phenomenal shallow well was completed by Shell Oil Co. on the Covarrubias lease in the El Capitan field. No. 1-29, bottomed at 1500 ft. and with 153 ft. of sand open, the well came in flowing 801 bbls. of 21.6 gravity clean oil through a ¾ in. bean. Flow pressure was only 25 lbs. and gas pressure measured 84,000 cu. ft. With the bean reduced to 20/64 in., production dropped to 65 bbls. of oil and 14,000 cu. ft. of gas, while the flow pressure rose to only 50 lbs. This is the third good well for Shell in recent weeks, Nos. 1-27 and 1-28 having also shown better than average yields.

Three Completed In Sta. Maria Valley

Three wells were recently completed in the Santa Maria Valley field, two by Union Oil Co. and one by the Bush-Hancock operating combination. Security No. 2, sec. 20, 10-34, was finished by the former company at 4682 ft., pumping 485 bbls. a day of 16.2 gravity clean oil. Vicente No. 4, sec. 21, bottomed at 5153 ft., was pumped in at the rate of 500 bbls. gross, but contained 10% mud and water. Bush-Hancock, Bradley Lands No. 3, sec. 26, pumped 600 bbls. after bottoming at 5390 ft.

Fred E. Cole, Santa Barbara operator, has made a location for his well No. 18 in lot 5 of the Paderewski Subdivision.

Mdivani Drills New Mesa Well

David Mdivani, former Georgean prince, and now a Beverly Hills oil magnate, through his operating organization ,the Trans-Oceanic Oil Co., is drilling a new well in the Santa Barbara Mesa field. Known as Mdivani No. 1, the project is now below 1700 ft. in depth.

Anacapa Oil Co., a Santa Barbara concern is making a production test after carrying Lowe No. 1 to 2125 ft. A blank liner was cemented on bottom and gun perforated.

General Petroleum Spuds La Laguna Wildcatter

Toward the end of finding production in the Monterey shale, General Petro-

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Colusa	Amerada Pet. Co.,Calif. Lands	1	34, 16-1	7266	Drilling
Glenn	Ohio Oil Co., Willard	2	18, 20-2	1950	Drilling
Humboldt	Texas Co., Eureka	2	22, 3-1	7708	Redrilling
Madera	Barnhart-Morrow, Arnold	1	22, 10-17	2025	Drilling
Monterey	The Texas Co., Lewis	1	1, 19-5	3510	Drilling
San Mateo	Wilshire Oil Co., Cowell	2	20, 6-5	500	Drilling
Solano	Richfield Oil Corp., Potrero	1	10, 4-1	4675	Drilling
Stanislaus	Orestimba Oil Co.	1	12, 7-7	765	Drilling

COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
Santa Barbara County					
Carreaga	Douglas-Stratton Oil Co.	1	8, 8-33	6240	Idle
Foxen Canyon	Richfield Oil Corp., Tinaquaic	1	36, 9-32		Rig
Gaviota	Gaviota Oil Co., Hollister	1	35, 5-33	3215	Idle
Gato Ridge	Barnsdall Oil Co., Mag.	5	9, 8-32	3035	Idle
	Pezzoni	1	15, 8-32	3525	Drilling
Lompoc	O'Donnell, J. E., Helen	1	8, 7-33	4725	Drilling
Los Olivos	Continental Oil Co., Laguna	2	25, 8-31		Rig
	General Pet. Corp., La Laguna	1	6, 7-30	950	Drilling
	Laguna Western, Bradley	1	15, 7-30	3279	Idle
Orcutt	Warren Deuel, Garrett	1	12, 9-34		Rig
San Luis Obispo County					
Edna	Loma Grande Oil Co., Lewis	1	28, 31-13	1475	Testing
Elk Horn	Calif. Pet. Prod. Co., Irons	1	19, 10-24	1710	Idle
	Lee, Harry Defiance	1	7, 32-22	225	Idle
	Western Plains Oil Co.	1	7, 31-21	4010	Idle
Huasna	Hancock O. Co.,Scherer-Dickes	1	30, 12-33	5593	Testing
Paso Robles	Vanguard Oil Co., Clark	1	26, 27-14	4950	Idle
Ventura County					
Ojai	High Mesa Oil Co.	1	16, 4-22	1730	Drilling
	Holly Dev. Co., Macrate	1	27, 4-23	4786	Abandoned
Red Mountain	Martin, J. W.	3	15, 4-21	1250	Drilling
Sespe	McKinnis, Chas., Cosley	1	14, 4-19	965	Drilling
	Merchants Pet., Cochran	8	1, 4-20	1200	Drilling
	Speik Oil Co.	1	33, 5-19	3440	Idle
	St. Louis Oil Co.	1	1, 4-20	608	Drilling
Shiells Canyon	The Texas Co., Shiells	135	4, 3-19	3565	Drilling
South Mt.	Clipper Oil Co.	1	17, 3-20		Rig
	The Texas Co., Richardson	5	13, 2-21	6702	Testing
Tar Creek	Section 20 Oil Co.	1	20, 5-19	2185	Drilling
Timber Canyon	Stallings, Senter, Ahlberg	1	24, 4-21	1445	Testing
Ventura	Ventura Drilling Co.	1	10, 3-23	825	Drilling

leum Corp., has spudded in its first test of the La Laguna Rancho in sec. 6, 7-30. Surface casing was cemented at 207 ft. and when last reported, the drill was below 1100 ft. in sandy shale. Continental Oil Co.'s second La Laguna well, located in sec. 25, 8-31, is standing rigged up and is awaiting release of a drilling crew.

Huasna Well Fails On Production Test

Scherer-Dickes No. 1, Huasna test of the Hancock Oil Co., has been a consistent disappointment to its followers. Tested by stages from bottom at 5593 ft., back to the shallow level of 900 ft., the well yielded only water with a small amount of heavy oil. Located in sec. 30, 12-33, the project appears to have suffered the same fate as the many other holes drilled in the vicinity—that of finding just enough oil to make keener the disappointment of failure.

Shell Edison 31 Flows 2221 Bbls.

Establishing a potential of 2221 bbls. Shell Oil Co. completed Edison No. 31 in the Ventura Avenue field from a depth of 8847 ft. The oil, which was free of water, tested 31 gravity and was accompanied by a 1,600,000 cu. ft. gas flow.

Tide Water Associated Oil Co., bottoming Lloyd No. 127 at 9900 ft., obtained 2033 bbls. with a cut of 17%. Gas was measured at 1,988,000 cu. ft. A formation test on the company's McGonigle No. 11 resulted in a flow of 870 bbls. in 16 hours from the interval 9445-10,125 ft. The well is being deepened below 10,200 ft.

O. C. Field Gets Pet. Sec. Home Ranch

O. C. Field, independent operator long interested in coastal fields, has acquired the Home Ranch property of Petroleum Securities Co. in Shiells Canyon. Although, not large oil producers, several wells on the lease are consistent commercial gassers.

Texas Co., largest developer of the field, is drilling Shiells No. 135 below 3575 ft. after making an unsuccessful formation test of the interval 3470-3495 ft.

O'Donnell Helen Drills at 4800 Ft.

J. E. O'Donnell, veteran California Independent operator, is drilling his Lompoc exploratory well, Helen No. 1, below 4800 ft. The well, located in sec. 8, 7-33, has encountered a few oil showings but nothing considered worthy of a test.

South Mountain Test Completed on Pump

With production gauging 80 bbls. of 21.6 gravity oil cutting 2.6%, The Texas Co. completed Yale-Richardson No. 5 on the pump after swabbing failed to cause the well to flow. Started as a deep test of the South Mountain field, the hole was carried to 6702 ft., but when no oil sand was found below 4030 ft., a plug was placed at that point and the well finished with 9⅝ in. casing cemented at 3930 ft.

Foxen Canyon Test Rigs to Spud In

Having completed the rig for Tinaquaic No. 1 in Foxen Canyon, Richfield Oil Co. is moving in machinery to start the drill. Prospects for finding Monterey production in this are considered to be rather good.

California Crude Oil Production

For Two Weeks Ended September 24, 1938

Field	Sept. Daily Quota	Average Daily Production	Excess
San Joaquin Valley			
Belridge—North	14,730	12,276	*2,454
Belridge—South	1,900	1,128	*772
Buena Vista	17,180	16,878	*302
Canal	2,815	2,807	*8
Coalinga-East(Eocene)	322	1,809	1,487
Coalinga—East-West	16,043	9,569	*6,474
Coffee Canyon	3,025	3,369	344
Edison	2,545	2,678	133
Elk Hills	7,920	10,499	2,579
Fruitvale	7,181	8,465	1,284
Greeley	,535	2,683	*852
Kern Front	8,125	7,880	*245
Kern River	5,470	2,638	*2,832
Kettleman No. Dome	61,890	64,018	2,128
Lost Hills	4,340	3,411	*929
McKittrick	3,425	3,173	*252
Midway	43,410	45,828	2,418
Mount Poso	14,195	15,070	875
Mountain View	9,115	9,654	539
Rio Bravo	4,575	8,150	3,575
Round Mountain	9,870	10,122	252
Ten Section	8,237	8,086	*151
Wasco	377	392	15
Other Fields	2,219	2,420	201
TOTAL	252,444	253,003	559
Coastal Counties			
Elwood	5,165	5,254	89
Rincon	2,935	3,494	559
Santa Maria	6,015	2,883	*3,132
Gato Ridge	2,440	4,685	2,245
Santa Maria Valley	19,450	15,410	*4,040
Santa Paula-Newhall	5,005	5,529	524
Ventura Avenue	31,680	34,532	2,852
Other Fields	5,660	6,098	438
TOTAL	78,350	77,885	*465
Los Angeles Basin			
Alamitos-Seal Beach	7,755	8,475	720
Brea-Olinda	8,420	5,647	*2,773
Coyote—East	2,700	3,134	434
Coyote—West	8,076	7,940	*136
Domingues	20,480	25,288	4,808
El Segundo	5,665	6,662	997
Huntington Beach—New and Old	26,485	31,823	5,338
Inglewood	13,720	14,115	395
Long Beach	44,195	56,810	12,615
Montebello	6,392	6,483	91
Montebello-West End	2,938	6,494	3,556
Playa del Rey	5,330	5,933	603
Richfield	7,805	7,860	55
Rosecrans-Athens	6,795	13,907	7,112
Santa Fe Springs	29,180	32,919	3,739
Torrance	12,965	18,350	5,385
Wilmington	68,440	93,262	24,822
Other Fields	2,660	3,057	397
TOTAL	280,001	348,159	68,158
STATE TOTAL	610,795	679,047	68,252

*—Shortage.

Jones & Laughlin Steel Seamless Bell & Spigot Casing

With the initial shipment to users in the oil fields, the Jones & Laughlin Steel Corp., Pittsburgh, announces the addition of a seamless bell and spigot casing to its present line of oil country products. This casing, made for welding in the well, features exclusively a die forged bell.

This new type is formed by upsetting the casing instead of the conventional expansion operation. This die forging operation forms a heavier bell wall, increases the effective welding area and assures a concentric correct diameter which its uniformity makes possible easy stabbing and helps to maintain true alignment of the bell and spigot during welding.

The die forging operation also provides a gentle slope or shoulder from bell to pipe wall which aids in relieving internal stresses arising from expansion during welding and transmits loads away from the joint while in service. In addition, the steel used in the manufacture of the new casing is of a grade especially selected for its welding properties.

A series of full section tensile tests show that in a majority of cases the joint strength was as great as the pipe itself, with joint efficiency records ranging between 96 per cent and 100 per cent. The new J & L bell and spigot casing will be available in sizes ranging from 5½ inches, O.D., to 10¾ inches, O.D., inclusive.

Hamer Oil Tool Co., 2911 Cherry Ave., Long Beach, Calif., has a publication of considerable interest to operators in its 1938 complete catalogue and price list. Among the items described are the Hamer Union Line Blind, the Hamer E-Z Turn Pressure Balanced Lubricated Round Hole Plug Valve, the Hamer E-Z Turn Swivel Goose Neck Plug Valve, the Hamer E-Z Turn Lubricated Manifold Plug Valve, the Hamer Squeeze Tight Pressure Expanding Slush Pump Piston, the Hamer E-Z Qut Slush Pump Liner Sleeve, and the Hamer E-Z Out Slush Pump Valve and Seat.

Lane-Wells Co., 5610 S. Soto St., Los Angeles, in the September issue of their regular monthly bulletin, discuss interestingly the "Development of Gas/Oil Ratio Control". A bibliography on the subject accompanies the discussion. As usual, the section of the bulletin, "In Brief," is a useful collection of abstracts of production articles which have appeared recently in the trade publications.

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New Type Liner Setting Tool Is Announced By Security

The Security Engineering Co., Inc., Whittier, Calif., has announced the development of a new type liner setting tool that incorporates a novel and fool-proof releasing action. The back-off connection between the liner and run-in string is of the conventional wide thread, left-handed type but the unique features of this setting tool are the devices which hold the liner from rotating while the back-off operation is in progress, and the floating head which takes the weight off the releasing thread. Because of these features the Security Liner Setting Tool can be used to run both light and heavy liners, or other similar equipment, with the positive certainty that release can be effected, the manufacturers say.

The tool consists essentially of a mandrel with a regular tool joint connection on its upper end and a ball bearing thrust washer on its lower end. The upper half of this mandrel between the tool joint and thrust washer has a square cross section, and the floating head, with a correspondingly square hole through it, is free to move up and down on this squared section. This floating head carries the conventional left-hand back-off connection from which the liner is supported by means of a liner adapter.

The assembly is run in the hole in the conventional manner and when the liner strikes bottom the floating head (to which the liner is fastened) slides up on the mandrel, thereby taking all weight off the releasing thread. As the run-in is lowered a little more the thrust bearing on the end of the mandrel seats on a shoulder provided for it in the adapter. This permits the full weight of the run-in string to be placed on the liner, thus locking it against rotation, and at the same time preventing any weight being placed on the back-off thread. Then the liner is positively held in position while the run-in string is backed off by rotating to the right the required number of turns. It is not necessary to raise the run-in string while releasing, because the floating head is free to move up the squared section of the mandrel as the threads disengage. The entire operation is under positive control of the operator at all times, the engineers report.

Other important engineering features of this tool include accommodation for a tail pipe in the end of the mandrel, and a cup-type packing assembly between the floating head and mandrel. These features assure effective cementing jobs, permitting the cement to be discharged at the proper place and safeguarded against leakage around the floating head even under high pressure cementing operations.

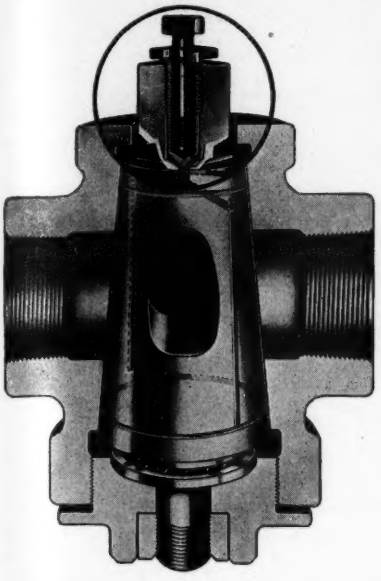
The Security Liner Setting Tool is made in a wide range of sizes to meet every production requirement. Detailed information on this may be obtained by writing to Security Engineering Co., Inc., Whittier, Calif.

A decision of the Washington supreme court has held that the Washington Use Tax was designed to protect Washington merchants against non-resident competitive merchants and does not apply to articles purchased outside the state which are neither manufactured nor available for purchase within the state.

Motor truck trains with ten trailers are burning up the mileage on Italy's new express roads. A concrete ridge in the middle of the road is straddled by the trucks, which have rollers that fit against the sides of the ridge.

New Packless Type Hi-Pressure Manometer

A new device which, it is claimed, eliminates all gas or fluid leakage during plug valve lubrication has recently been announced by MacClatchie Manufacturing Co., Compton, Calif. This MacClatchie feature, known as "Lubricheck," is standard equipment on all new MacClatchie "Hydro-Seal" Plug Valves. It is especially designed to give longer wearing life to the valve through positive



lubricating action and simple operation, and to eliminate the danger of regreasing plug valves under pressure, it is said.

"Lubricheck" consists essentially of a tapered seal which seats against the opening of the lubricating chamber and closes off all gas or fluid while the lubricating screw is removed. The tapered seal is equipped with left-hand threads on its outer surface, and less than a quarter turn tightens the seal against the seat. As the right-hand Lube Screw, located inside the seal, is removed, the friction obtained serves to further tighten the seal against the seat, thus making possible a fluid-tight seal under extremely high operating pressures. To lubricate, a MacClatchie Grease Stick is inserted, the Lube Screw replaced and tightened. Turning to the right automatically loosens the seal of the "Lubricheck" and opens the grease channels. Grease is then forced into the channels and lubricates the entire body and plug of the valve.

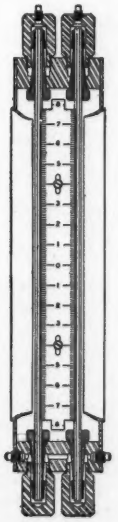
Simple construction of "Lubricheck" eliminates quick wearing parts which often do not thoroughly seal off the grease chamber and therefore allow line pressure to force the grease out of the valve when lubricating. No sand or mud can interfere with proper operation of the "Lubricheck," and quick easy adjustment, or complete removal, of the Lube Screw can be accomplished with no gas or fluid leakage, the manufacturers say.

The positive sealing action of the "Lubricheck" is a definite safety feature for refineries or gas plants where fire hazards must be eliminated. Spraying fluid and leaking gas are entirely eliminated, and a more thorough check-up for proper plug valve maintenance can be carried on with complete safety through the use of "Lubricheck."

MacClatchie "Hydro-Seal" Plug Valves, equipped with "Lubricheck", are available in many sizes for all field and pipeline operations, in screwed, flanged or union ends, and hand or gear operated.

New Mechanical Device For Plug Valve Lubrication

A new straight tube, high-pressure manometer suitable for pressures up to 1,000 pounds is being introduced by the Daniel Orifice Fitting Co. of Los Angeles. The design of this new Wilcox Manometer, Patent No. 2,088,777, permits the use of straight tubes which are sealed positively against leakage by synthetic rubber sleeves, thus eliminating strain or stresses in the glass. The construction does away with stuffing boxes and provides a compensating seal under pressure.



Because there is no U-bend and only the lightest contact between glass and metal parts, there is no distortion of the tubes when seal is made. Every part is easily accessible, impervious to gas, oil, gasoline, etc., and easily cleaned. If glass is accidentally broken, only one side need be replaced. Full details of the Wilcox Manometer are available from the Daniel Orifice Fitting Co., Dept. 110-K, 3352 Union Pacific Avenue, Los Angeles, Calif.

Saturday and Sunday closing of oil wells in Texas will continue through October with the exception of the last week-end of that month.

Furnishing of tires pursuant to a tire mileage contract under which the tire company agrees to furnish satisfactory tire equipment at a stipulated amount per mile of operation, the company retaining title to the tires, constitutes a service rather than a sale of tires.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, and MARCH 3, 1933.

Of California Oil World & Petroleum Industry, published semi-monthly at Los Angeles, California, for October 1, 1938.

State of California, County of Los Angeles, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Walter C. Monroe, who, having been duly sworn according to law, deposes and says that he is the President and Business Manager of the California Oil World & Petroleum Industry, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Walter C. Monroe, 765 S. Plymouth Blvd., Los Angeles, Calif. Editor, Walter C. Monroe, 765 So. Plymouth Blvd., Los Angeles, Calif. Managing Editor, None. Business Manager, Walter C. Monroe, 765 So. Plymouth Blvd., Los Angeles, Calif.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member must be given): Petroleum Publishers, Inc., 714 W. Oympic Blvd.; A. A. MacDonald, 133 N. Las Palmas; Ward B. Blodget, 342 Pet. Sec. Bldg.; M. K. Miller Jr., 650 So. Spring St.; Arnold K. Fitger, 530 W. 6th St.; Walter C. Monroe, 766 So. Plymouth Blvd. All the above are Los Angeles, California addresses.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above is: (This information is required from daily publications only.)

WALTER C. MONROE
(Signature of business manager)

Sworn to and subscribed before me this 22nd day of September, 1938.

(SEAL) IRMA E. COMSTOCK.

(My commission expires Nov. 9, 1939.)

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Oil Men's Calendar

C.N.G.A. Meeting First Thurs. Each Month.

October

10-13—North American Gas Tax Conference, Tulsa, Okla.

10-14—National Safety Congress, Petroleum Section, Stevens Hotel, Chicago, Ill.

13-15—Society of Automotive Engineers, Aircraft Production Meeting, Ambassador Hotel, Los Angeles, Calif.

20-21—American Institute of Mining & Metallurgical Engineers, Industrial Minerals Division and Petroleum Division, Los Angeles, Calif.

24-26—National Assn. of Credit Men, Petroleum Refiners Division, Indianapolis Athletic Club, Indianapolis, Ind.

20-21—Industrial Minerals Division and Petroleum Division A.I.M.E., Los Angeles.

November

1-5—American Institute of Mining & Metallurgical Engineers, Regional Meeting, Tucson, Ariz.

1-15—American Institute of Mining and Metallurgical Engineers Regional Meeting, Tucson, Arizona.

3-4—American Assn. of Petroleum Geologists, Pacific Section, Los Angeles, Calif.

11-17—National Motor Truck Show, Port of New York Authority Bldg., New York.

11-18—National Automobile Show, Grand Central Palace, New York.

14—Society of Automotive Engineers, Annual Dinner, Commodore Hotel, New York.

14-18—American Petroleum Institute, 19th Annual Meeting, Stevens Hotel, Chicago, Ill.

December

5-9—American Society of Mechanical Engineers, Annual Meeting, New York.

Based on the ratio of population and highway mileage, incorporated cities of Los Angeles County will receive a total of $1,400,000 in state gasoline tax receipts from the county's share.

Exports of petroleum equipment from the United States during the first six months of 1938 reached a level record of $21,008,415, a 21 per cent gain over the January-June peak first-half-year figure, of $15,093,620 in 1930. Much of the demand has been for drilling equipment.